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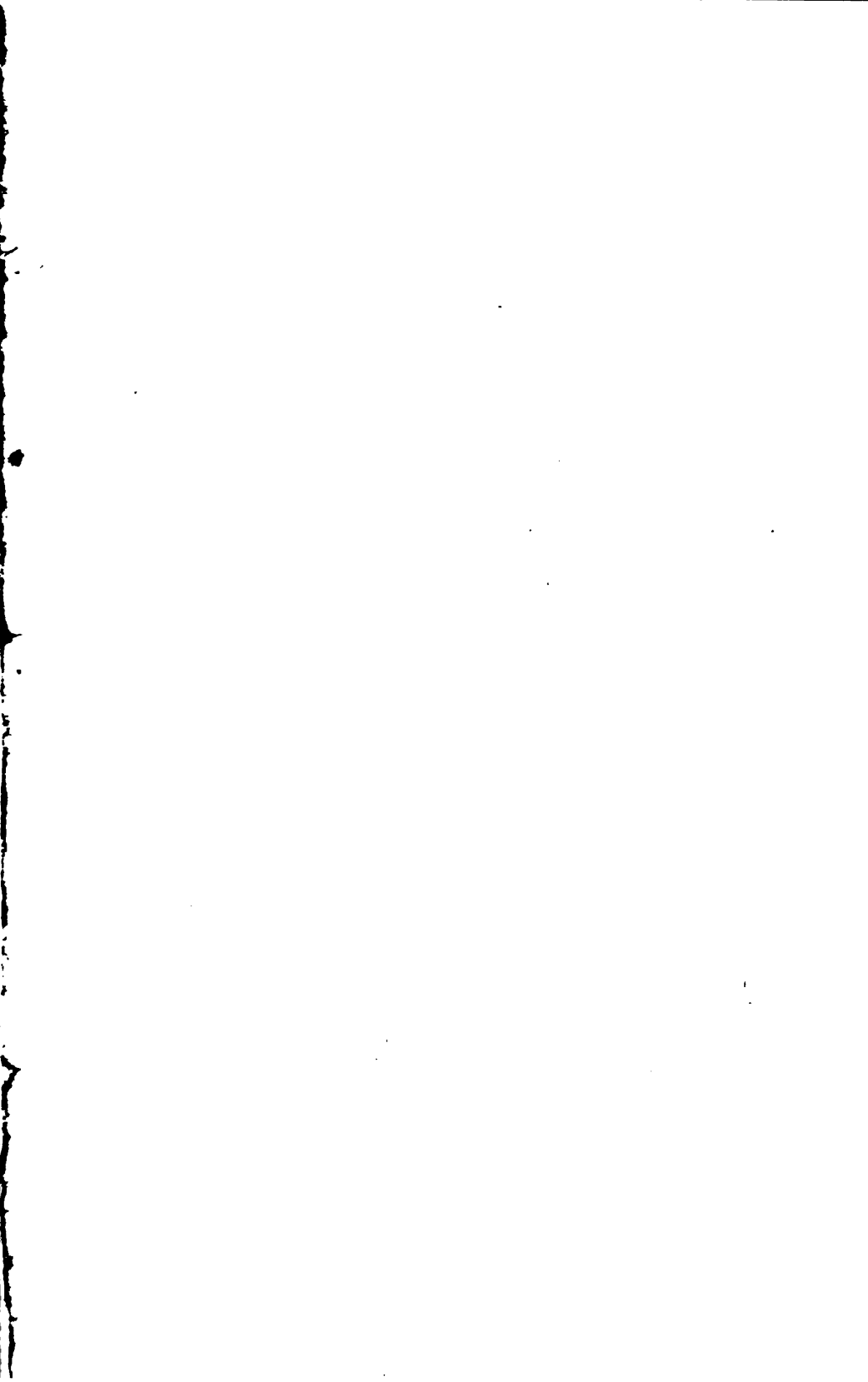
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No. 1.

THE MIGRATORY IMPULSE VS. LOVE OF HOME.

By LINUS W. KLINE, Fellow in Psychology, Clark University.

INTRODUCTION.

The migration of animals and peoples, the wandering of tribes and roving impulse of the individual, have been woven into legends and myths, carved upon stone and written upon parchment, ever since the advent of human thought.

The predatory advance of the locust,¹ the measured flight of certain butterflies,² the martial like procession of caterpillars and ants³ have long inspired wonder, superstition and thought, "The 'human race is more concerned in the movements and migrations of fish than in the question of their permanent abode.'" To the ancients the flight of birds was a token of prosperity or adversity according to the direction of the flight. If an eagle flew over from left to right or from right to left, the former was regarded a good omen, the latter an evil one. Among the hieroglyphs on the monuments of the Pharaoh's are represented wild-geese fowling as these birds were making their annual migrations through the Nile Valley. The ⁴prophet Jeremiah in rebuking the seared consciences of the Jews, spoke in this fashion: Yea, the stork in the heavens knoweth her appointed times and the turtle and the crane and the swallow observe the time of their coming; but my people know not the judgment of the Lord.

The folk-lore of many tribes, the beginnings of many great

¹ Fignier: The Insect World. Page 302.

² Couch: Illustrations of Instinct, pp. 145-150.

³ Huber: Ants.

⁴ Baird, Spencer F: U. S. Fish Com. Report, 1886, p. 47.

⁵ Jeremiah 8: 7.

nations in addition to historical facts, consist of migratory legends and myths of wandering.

The tradition of the Hebrew, which tells of their migration into Palestine from the countries across the Euphrates, is substantiated by their tribal name, *ibri*, *i. e.*, one who has crossed. The Doric traditions of an immigration from Thrace and Macedonia through Epirus into Greece is confirmed by linguistic facts. The legendary account of the migration of Cadmus, leading to the foundation of Thebes, the checkered and wandering life of Æneas, previous to his marriage and settling in Italy, the adventurous and romantic journey of Ulysses from Troy to Ithaca have given to literature its classic wanderers for all time.

All tribes of the Maskoki stock of Indians,¹ likewise the Washoe around Carson City and Tinne-Appache of New Mexico possess migration legends intermingled with myths and mythic ideas. Many of the ²Polynesian tribes have similar traditions.

In recent times Germany and Austro-Hungary have established stations for observing bird migration. Scientists of Great Britain utilize part of her lighthouse service for collecting data on bird movements. In our own country many men of the weather bureau service have divided their time between observing weather phenomena and collecting data on the flight of birds.

Several attempts³ have been made by naturalists and anthropologists⁴ to trace out the migrations⁵ of man from his⁶ primitive home until he had peopled the whole earth. Journalism⁷ has recently given some space to accounts of roving and tramp⁸ life. Within the past two years some systematic study has been devoted to Truancy,⁹ chiefly¹⁰ along statistical, sociological and anthropometrical lines.

The writer was brought face to face with this instinct while in conversation with a few of the beneficiaries of the associated

¹ Gatschet, A. S.: *A Migratory Legend of the Creeks*, p. 218, Phil. 1884.

² Sittig, Otto: *Compulsory Migrations in the Pacific Ocean*. Smith. Report, 1895, pp. 519-35.

³ Sittig Otto: *loc. cit.*

⁴ Mason, O. F.: *Amer. Anthro.*, Vol. II, No. 3, 1894, *Migration and the Food Quest*.

⁵ Brinton, G. D.: *Races and People*.

⁶ Müller, Friedrich: *Allgemeine Ethnographie*.

⁷ Noble, C. W.: *Border Land of Trampdom*. Pop Sci. Month, Vol. L, p. 252.

⁸ Flynt, Josiah: *Century Vols. XXIV and XXV*, 1893. Same author in *Atlantic Month*. Vol. LXXVII, p. 88.

⁹ *Fifty-ninth Annual Report, Board of Ed. of Mass.*

¹⁰ *Pedagogical Seminary*, Vol. V, No. 3, 1898.

charities of Boston. A description of one will suffice, for in respect to this trait they differed but little.

A young man of American parentage who had just recovered from a spell of sickness in a Boston hospital presented himself to the manly department of the association asking for money to purchase a ticket to Springfield, Mass. He seemed very anxious to get work again and had a strong hope that he could do so were he only in Springfield. He produced evidence showing that he was a skilled workman and had given satisfaction to his employers. It was found that he had come from New York and to New York he had gone from Springfield, Mass., to which latter place he now longed to return, though he had neither home nor relatives in the place. He had paid his respects to each of these four cities within five months. No particular reason could he assign for leaving any one place, except that he thought a change was good for him. After remaining a certain length of time in a place, familiar objects and places became distasteful, even the odors of the shop would haunt him and at times the very sight of shop comrades would appear repulsive. Peace of mind came only by breaking away and entering into the life of a new place. He recognized painfully that it was not the way to provide for a rainy day nor to become a practical citizen.

Says Flynt: "I have known men on the road who were tramping purely and simply because they loved to tramp. They had no appetite for liquor or tobacco, so far as I could find, also were quite out of touch with criminals and their habits; but somehow or other they could not conquer that passion for roving. In a way this type of vagabond is the most pitiful that I have ever known; and yet is the truest type of the genuine voluntary vagrant. . . . To reform him it is necessary to kill his personality, to take away his ambition and this is a task almost superhuman. Even when he is reformed he is a most cast down person."

"Ten² years ago four young men of this city took a pedes-

¹ Flynt, Josiah: Century, Oct., 1885, p. 941.

² One of over 500 cases taken from Rubrics II and IV. See Syllabus below.

TOPICAL SYLLABI FOR CHILD STUDY.

(Series for Academic Year 1896-7).

III. MIGRATIONS, TRAMPS, TRUANCY, RUNNING AWAY, ETC., vs. LOVE OF HOME.

I. Consider whether you know any small child with a propensity to run away; and if so describe the circumstances—why, when, where it went, whether alone, and planned, or impulsively, and all the details and incidents of each case; its adventures, how it was found,

trian trip to the Delaware Water Gap. They were all of good families and of excellent habits. On returning home three of them resumed their every-day life, but F., who was about twenty years old, after staying home several days disappeared and did not return for several weeks. When he came back he told the alarmed family that he had been on another tramp. Since that time he has been all over the United States working only when he could not obtain food or lodging otherwise. He returns home at intervals but stays only for a few days, and does not appear to have formed any bad habits, but cannot overcome the desire to wander. He still seems to have affection for those at home, yet cannot content himself to stay with them. As none of his relatives have led adventurous lives, his parents cannot account for his strange behavior."

whether deterred later by its experiences, at what age this disposition appeared and when it ceased and why.

II. Describe the same with boys and girls in their teens, who leave home for love of adventure, anger, impatient of restraint, to start life for self, etc., definite plans or none. Give every incident of cause, experiences, hardships, etc., you can find out.

III. Describe any case of truancy from school or church, its motives, traits of the child, mode of concealment.

IV. In your own experience what are the charms of travel in order of interest, whether of a trip to Europe, a ride or bicycle journey, a lonely walk of a day's duration, globe-trotting, etc. Have you ever left home aimlessly, and before leaving had you lost property and friends or been injured in feelings? Have you been tempted to "disappear," and what reasons, or left home to "do the world" or "paint the town?" Have you ever suffered intense hunger, and if so describe your feelings.

V. What do you know of tramps? have you ever interviewed one, or can you do so? what have you ever read or heard of them?

VI. Do you know people who move frequently, and if so, state why, where, how often and all you know of them.

VII. Do you know anything of gypsies or can you find out any thing?

VIII. Do you know an inveterate visitor, call-maker, gad-about person, who must be always on the street or on the go? If so describe them carefully, and see if you can account for it; or of boys with a passion to start out for themselves exceptionally early in life.

IX. The same of any one who loves home so intensely that he or she will only very reluctantly go away for, or be away nights.

X. What are the elements in your own love of home in order—as love of father, mother, brother, sister, the house, hills, trees, and natural scenery, familiar ways of life, etc.

XI. Describe any case of homesickness you know of and especially if you have experienced it yourself.

XII. Describe your own experiences with spring fever, ennui that impelled you to go or be far away, longings in the distance, desire to break away and see the great world and take a part in its actions. Have you ever felt thus concerning a future life as connected with either *religion, love or conflict*?

In each case specify each of the following points: 1, age; 2, sex;

Here, then, is an activity of the soul, woven into legends and folk-lore, is discussed in history and science, and affects profoundly the social and domestic life of a people. An instinct that destroys for the time being even the activities that provide for the immediate wants of life, that drives out considerations for home, relatives and friends, that overpowers the sympathetic, the domestic, the home-making spirit of man, that unfits him for static toil and conditions, and impels him to seek a change, the new, strange and untried.

Modern biology in its interpretation of *form and function* begins its work with the undifferentiated organ or organism in question, and follows it through its phylo-ontogenetic developing paths, both by the methods of experimental morphology and comparative anatomy until present conditions are reached. The verdict of these methods, especially the former, is that the efficient causes in the process are first,¹ "internal causes,

3, nationality; 4, occupation of parents; 5, are one or both living? 6, do they own their homes? 7, is their food and clothes good? 8, toys; 9, books; 10, pin-money; 11, affections; 12, has the child any physical defects? 13, is it oldest, youngest or only child? 14, is it quick-tempered? 15, sensitive; 16, demonstrative; 17, laugh and cry easily; 18, cheerful; 19, active; 20, generous; 21, fond of playmates or reticent and inclined to be alone; 22, does it seek to govern others and does it obey readily? 23, love or shun crowds; 24, or dark; 25, animals; 26, deep water; 27, out of door life, fondness for woods, fields, etc.; 28, does it love music, does it dance? 29, a good color sense, and what are its favorite colors? 30, is it careless or tidy and dressy? 31, has it had pets, is it good to animals? 32, careful of property; 33, and of others' rights; 34, made a collection of things; 35, is it persistent in carrying out tasks? 36, is it inquisitive and talkative? 37, were there ample opportunities for taking exercise, were games and sports encouraged? 38, was there plenty of physical or manual labor at home? 39, must there have been long hours of sedentary work at home and in school? 40, *always specify the season of the year of every incident if possible*; 41, was their immoderate love of sight-seeing, being out evenings, camping out, hunting, excursions, picnics, etc.?

XIII. What have you observed concerning the migrations and the homing instincts of animals, cats, dogs, cows, horses, hens, rabbits, pigeons, fish, ducks, etc., etc.? What have you read, and can you send or refer to any literature or reports of cases? What have you observed of any lower forms of life that move freely at first and then become sessile or fixed as parasites, of nuptial flights of insects?

XIV. What special literature can you refer to on tramps, homelessness, truancy, gypsies or on any other aspect of this topic?

In any case giving the full name of any part of it is optional with the one answering.

Kindly send your answers to

G. STANLEY HALL,
or L. W. KLINE.

CLARK UNIVERSITY,
Worcester, Mass., Oct. 26th, 1896.

¹ Davenport, C. B.: Experimental Morphology, Part I, p. 8.

which include the qualities of the developing protoplasm ;" second, "external causes, which include the chemical and physical properties of the environment in which the protoplasm is developing."

The genetic psychologist has taken his cue from the biologists, and accordingly—after making certain assumptions, a feature common to all sciences, concerning the relations of mind¹ and body,² heredity and the like, unnecessary to discuss here—goes back to primitive psychic life, and investigates both the causes and the processes in its development until it reaches conditions found in the adult form. The factors believed to be operative in originating and determining the causes of psychic differentiation are (1) those inherent in the *principle life* itself; (2) *cosmic*, including chemical substances, moisture, heat, pressure, light and electricity, and their innumerable combinations and ever changing relations to each other and to *life*; and (3) *social*, meaning by the latter all those influences that proceed from members of the same family, tribe and species, together with all other species, both plants and animals. Dr. Brinton³ writing on the role played by social influences in psychical differentiation says: "The psychical development of men and nations finds its chief explanation, less in the natural surroundings, the climate, soil, and water currents, as is taught by some philosophers, than in their relations and connections with each other, their friendships, federations and enmities, their intercourse in commerce, love and war." To present the point of view of the present investigation, to sensitize our minds as to the delicacy of the interaction between cosmic forces and life, and the nature of the latter's response, I propose to give, very briefly, indeed, the results of some experiments and observations on temperature,⁴ one of the most vital forces operating on organic life.

¹"The process of psychical evolution runs parallel with the evolution of organic life." Paulsen: Introduction to Philosophy, p. 143.

²"The key-note of modern biology is evolution; and on the hypothesis of scientific monism here adopted. . . . We are not only logically justified in extending our comparative psychology so as to include within its scope the field of zoological psychology, but we are logically bound to regard psychological evolution as strictly co-ordinate with biological evolution." Lloyd Morgan: Introduction to Comparative Psychology, pp. 36-37.

³Brinton, G. D.: *loc. cit.*

⁴It should be remembered that temperature is only one among many determining developmental factors, and that what is presented here is merely a type of a large number of studies made on the behavior of protoplasm in the presence of chemicals, density of fluid medium, gravity, electricity and light. Doubtless the most comprehensive modern works of experimental morphology are Loeb's Untersuchungen z. Physiologischen Morphologie, d. Thiere, 1892; M. Verworn's Allgemeine Physiologie, 1895; and C. B. Davenport's Experimental Morphology, 1897.

What quantitative limitations does temperature impose upon life?

The range of life in temperature is less than 100° of the temperature scale. "So¹ delicate is the adjustment between living matter and the conditions by which it is environed that if the mean temperature of the earth were raised or lowered through only a few dozen degrees, the teeming creatures of air, water and land, would cease to exist." Upon this point Professor Shaler² observes: "The range of heat which life can sustain may be taken as less than 100° ; but in the sun we have a temperature which cannot well be estimated as less than a hundred thousand degrees Fahrenheit, and in the depth of the earth is probably to be measured by tens of thousands of degrees on that scale, while in the realm of ether between the solar and terrestrial spheres there is a degree of cold which is certainly to be reckoned as some hundreds of degrees below zero. Amid these contending extremes of heat and cold life must find its narrow place." If these inconceivably large numbers be expressed in linear terms, we have a line one hundred thousand inches in length, an extension of about one mile and a half, let the space of each inch represent one degree Fahrenheit. On that scale mark off a space of eight feet near one end and this trifling part of the length of the whole line gives us a diagrammatic representation of the ratios between the temperatures of the solar system and those in which organic life can be maintained. This delicate adjustment of life to temperature is clearly expressed by spatial limitations. "It is highly probable that at no time since the beginning of life in the unstable material forms as we know it, has temperature conditions necessary for life existed much over five miles above the level of the sea even at the equator."

Relations of life to temperature considered experimentally. The casual observer knows that fowls droop their wings, that swine hunt the wallow and the ox the shade of the oak in hot weather. Every farmer, gardner and florist knows well that the effectiveness of the hot-bed and green-house in producing vigorous, healthy plants, depends upon a very narrow range of temperature.

The experimental investigations of Velten,³ Kerner,⁴ Mendelssohn,⁵ Verworn,⁶ Loeb⁷ and others show quantitatively the

¹ McGee: Anthropological Society, Washington, D. C., 1894.

² Shaler, N. S.: Interpretation of Nature, pp. 67, 68-117.

³ Velten. Quoted by Davenport: Experimental Morphology, pp. 226-227, 1897.

⁴ Kerner: The Natural History of Plants, Vol. I, pt. 2, pp. 557-8. (Tr. by Oliver.)

⁵ Mendelssohn: Archiv. fur die ges. Phys., Band 60, 1895.

⁶ Verworn: Allgemeine Physiologie.

⁷ Loeb: Untersuchungen z. Phys. Morphologie, d. Thiere.

exceeding sensitiveness of protoplasm to temperature. Englemann,¹ Edward,² Mendelssohn, Cambell,³ Davenport, have demonstrated that in general protoplasm is more responsive the closer we approach its optimum temperature—a temperature of about 30°C.

A more direct line of evidence showing the relation of the activities of protoplasm to temperature is found in the fact that organisms, in general, absorb more oxygen and excrete more carbon dioxide the higher the temperature within certain limits.

This has been sufficiently proven by the germination and growth of seedlings,⁴ by the increase of rhythmic movements of the contractile vacuole of infusoria in rising temperature.⁵ Numerous⁶ experiments on air breathing⁷ animals confirm the same general law, and, furthermore, establish a relationship⁸ between the oxygen absorbed and the carbon dioxide given off. But nowhere do I find experimental evidence on the quantitative differences between either the absorption of oxygen or the excretion of carbon dioxide at the optimum of an organism and at temperatures above and below that point.

I present here in detail a series of experiments carried out on tadpoles⁹ with a view to gain some evidence on this problem. The first¹⁰ part of the problem was to ascertain

¹ Englemann, Th. W.: Flimmeruhr u. Flimmermühle Zwei, App. Z. Register d. Flimmerbewegung. Pflüger Archiv. f. Phys., pp. 501-502, Vol. XV, 1877. (See Fig. 1 and F. af 6.)

² Edward, Chas. L.: Stud. Biol. Lab. Johns Hopkins Univ., Vol. IV, 1888, pp. 19-35.

³ Campbell: Stud. Biol. Lab. Johns Hopkins Univ., Vol. IV, pp. 123-145.

⁴ Vine, S. H.: Physiology of Plants, p. 198. (See table.)

⁵ "From all these facts we may conclude that, within certain limits, an increase of temperature increases metabolism, and a diminution of temperature diminishes it." Davenport: Experimental Morphology, p. 225.

⁶ Regnault et Reiset: Recherches chimiques sur la respiration des Animaux des diverses classes. Annales de chimie et Physique, pp. 299 et seq.; 3me Ser; Tome 26, 1849.

⁷ Colosanti: Ueber den Einfluss der umgebenden temperatur auf den Stoff wechsel der Warmblütes Pflüg. Arch., Vol. XIV, pp. 92, 469, 1877.

⁸ Page: External Temperature Affecting the Amount of CO₂, etc., Jour. of Phys., Vol. II, p. 228, 1879-'80.

⁹ I chose this form of animal because it lends itself readily to a variety of experiment with comparatively simple apparatus, and also on account of its delicate and ready response to changes of environment.

¹⁰ For this purpose a zinc trough 20cm deep, 16cm wide and 2.3 meters long, supported by a wooden frame, was constructed. To the bottom of the trough 16cm from one end a tin box 12cm wide, 15cm long and 6cm deep was soldered. The box received water through a hole cut in the zinc. Water was conducted to the hole through a stand pipe soldered to the inside bottom of the trough. The tin box served two purposes: first, it admitted a direct application of the

whether or not the tadpole will choose voluntarily his optimum.¹

(1) Sixty-seven tadpoles were placed in the middle of the rectangular trough, the temperature of the water being 4°C throughout. They leisurely distributed themselves equally throughout its whole extent. Heat was now applied to the left end, the right end resting on iced sawdust. When the left end reached 16°C the tadpoles began to congregate in that region, and especially about the standpipe. No one remained very long in any one place, though they did not appear at all uncomfortable. Each movement was attended by a leisurely indifferent motion of the tail, as if the rising temperature was a source of comfort. The temperature at the right end at this moment was 6°C, containing only a few tadpoles which seldom moved. At 20°C the left end was crowded, thus showing that for that temperature they are positive thermotactic. At 24°C the tadpoles showed marked discomfort. The movements were no longer of an indifferent lazy waggle, but were decided and quick, showing that they were beginning to experience uncomfortable quarters. As yet, however, there were no movements in a definite direction. Between 25°C-26°C migrations began toward the right end, which had risen to a temperature of 15°C. At 27°C migrations to the right end were continuous, and at times not a single creature remained in the region of the left end. Tadpoles occupying an intermediate position between the two ends, temperature 18°C, sniffing, as it were, a warmer region toward the left, frequently darted suddenly for it, only to find themselves in hot water, out of which they immediately migrated. The eight thermometers at twelve inches apart registered temperatures shown in Fig. I, Diagram 1. (2) When the temperature of the left end reached 36°C and the right end 26°C the heat was turned off. The left end was allowed to cool by the ordinary process of radiation into the air of the room, while the right was hastened by artificial means. When the latter had fallen to 18°C during 12 minutes, the left end registered 28°C, toward which, but not to it, a slow movement began and increased more and more as the temperature fell at both ends. When the left end had fallen to 24°C and the right

flame to its surface, and thereby protecting the zinc bottom, and second, the water heated in this vessel transmitted its heat to the zinc over a surface equal to the area of the tin vessel; thus preventing an excessively high temperature in one spot, which would have resulted by a direct application of the flame. Depth of water in trough was two and one-half inches. A board strip containing one-quarter inch holes six inches apart was laid lengthwise of the trough. Thermometers were thrust through eight of these holes, and allowed to dip two inches below the surface of the water.

¹A summary of these experiments appeared in *Ped. Sem.*, Vol. V, No. 3, 1898.

end to 10°C the migration toward the left were about complete. A few remained behind entangled in the ice, besides a few scattering ones at intermediate points, but the great bulk were huddled in together at the left end tadpole fashion. The cooling continued until both ends reached, respectively, 18°C and 19°C. The temperatures of the intermediate thermometers were noted and the number of creatures in the region of each counted, which is shown in Fig. II. This is a clear expression of negative thermotropism at temperatures below 18°C. Now, since they move away from a temperature of 26°C toward a lower one, and away from a temperature of 18°C toward a higher one, it is evident that there must be a temperature somewhere between these two points which is agreeable or most favorable for the tadpole—its optimum.

(3) The tadpoles were removed from the trough, and the left end was raised to 35°C, the other reduced to 0°C. Fifty fresh tadpoles were then put into the tank at a point registering 10°C. Within five minutes they took the position indicated in Fig. III. I removed them from the tank to a vessel containing water at 12°C—temperature in which they were then being kept, where they remained 45 minutes, after which they were transferred again to the tank and put in at a region registering 26°C. In a very short time the position indicated in Fig. IV were taken. The several temperatures were kept constant for ten minutes, during which time the number at the temperatures were counted, but at no time were the numbers materially changed from those already given. At times there was more or less moving, now toward the cooler region, now toward the warmer, but their little excursions nearly always ended in the region between 19°C and 24°C.

The conclusion is that the optimum for the tadpole is between 19°C and 24°C. This conclusion is supported by three other facts. (1) Their respiration curve rises very suddenly at 24°C. [See Chart I]. (2) The maximum amount of CO₂ is produced between 19°C and 24°C. (3) Their refusal to eat in temperatures above 24°C. (They will eat, however, in temperature as low as 10°C). The curves¹ of Chart I indicate the

¹ The apparatus consisted of a tall narrow glass jar, depth 28cm, and diameter 9cm. It was filled with water. The tadpoles were confined within narrow limits, and prevented from direct contact with the bottom of the glass jar by a partition spaced off by two circular pieces of wire gauze 8.5 in. diameter, placed horizontally in the jar 6.5cm apart. These two wire platforms were held *in situ* by a wooden rod thrust through their center and resting on the bottom of the jar, which was placed in a sheet-iron kettle containing five liters of water. The bottom of the glass jar was allowed to barely touch the surface of the water in the kettle. These conditions secured a slow and uniform rise in temperature. Two thermometers were placed at different levels within the space confining the tadpoles.

DIAGRAM I.

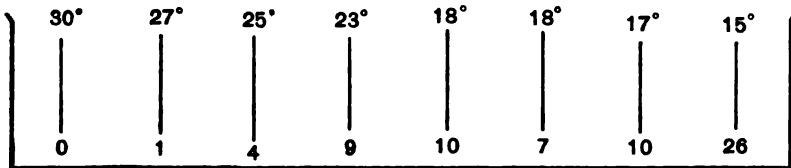
Thermotropism of tadpoles.

FIG. I.

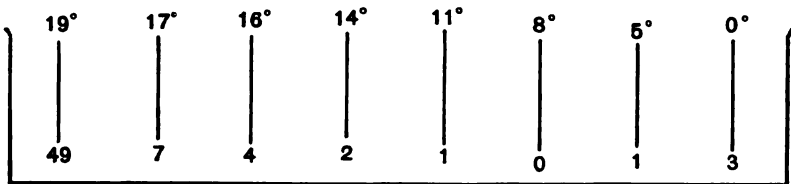


FIG. II.

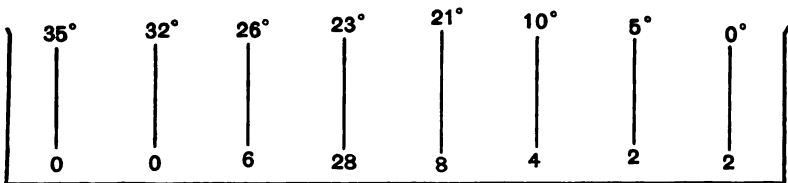


FIG. III.

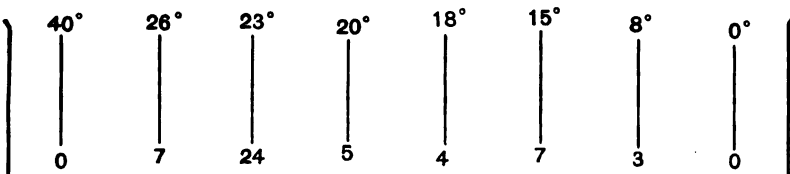
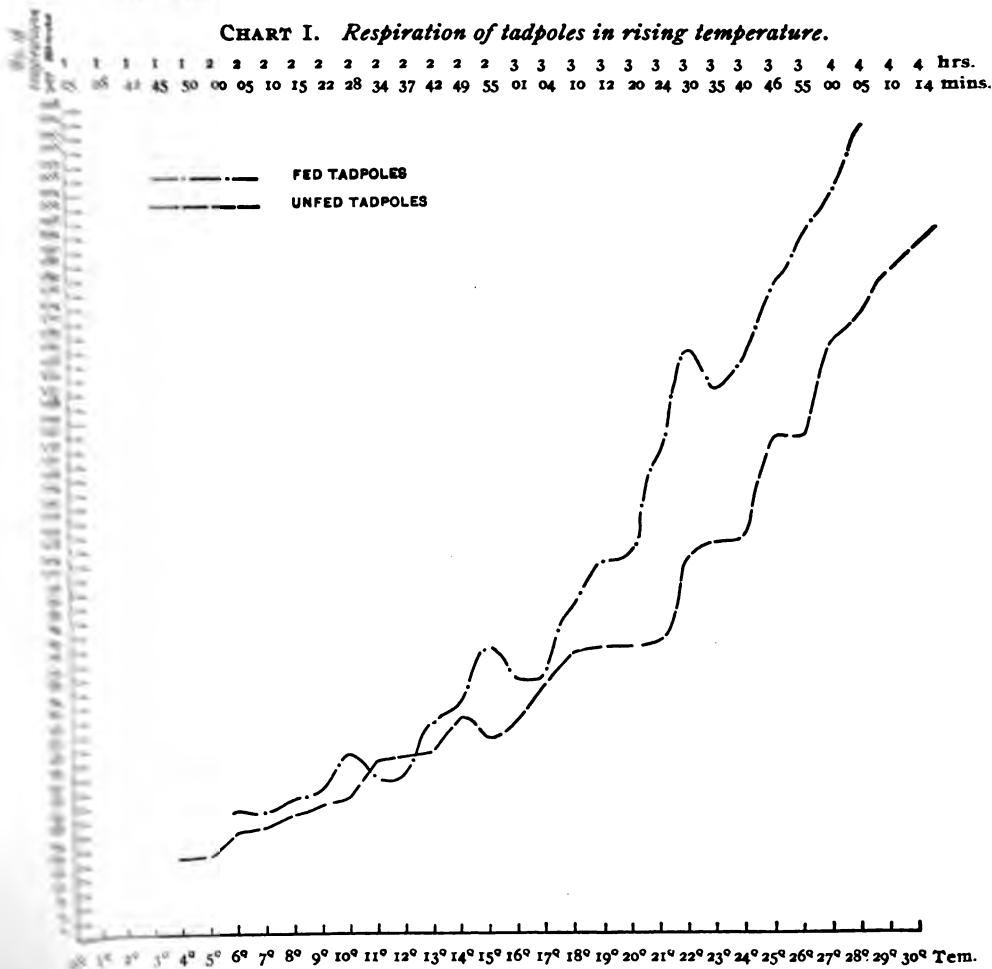


FIG. IV.

The vertical lines represent thermometers. The lower row of figures indicate the number of tadpoles in the region of different temperatures. The upper row of figures indicate temperature in degrees centigrade.

effect of rising temperature on the respiration of tadpoles. The temperature was raised from 0°C to 30°C in 165 minutes, or 1°C in 5.5 minutes. The lean, unfed tadpoles began to breathe at 4°C , those well-fed at 6°C . At these temperatures I was able to count from 20 to 24 respirations per minute. Often,

CHART I. *Respiration of tadpoles in rising temperature.*



however, no respiration could be detected below 5°C . From 5°C up to 20°C the increase is quite uniform. At 21°C the obese tadpoles increase their respiration 54 to the minute, the lean ones defer any sudden rise until 24°C . Divergence in their curves begin at 17°C – 18°C . Attention is called to the

fact that the increase in respiration from 24°C to 30°C , or through 6°C equals that from 5°C to 24°C , or the increase through 19°C . Thus showing that any increase of temperature above 24°C produces effects altered in character to those of like increments below that point. Another inference made here is that, since metabolism is a function of respiration (taught long ago by physiologists), and that the latter stands in causal relation to temperature, metabolism bears a vital relation to temperature. The second part of the problem was to enquire more closely into the nature of this relation. What is the quantitative difference between the metabolism at the optimum and at temperatures above and below that point, as indicated by carbon dioxide¹ produced at different temperatures?²

The determination of CO_2 produced by air breathing animals is usually effected by aspirating the exhaled air over barium hydrate or a soda solution contained in Pettenkorf or U tubes. The difference in the weight of the tubes before and after the aspiration of the expired air is taken as the weight of CO_2 produced after making certain corrections.

With water breathing animals the problem is more complex. Water is a solvent of carbon dioxide. The extent of the solvency depends on the temperature and pressure. In this instance the normal pressure was lessened by the aspirator employed to supply the water containing the tadpoles with oxygen. This diminution of pressure favored the escape of a portion of the carbon dioxide from the water. The problem narrowed into the estimation³ of the carbon dioxide left in the water and of that which continually escaped into the tubes. The amount found in the former I have termed the "volumetric

¹ The inference that a quantitative determination of CO_2 is a measurement of metabolism is based on the following well-known facts: "Oxygen is concerned with the integrating, the anabolic process, on the other hand carbon dioxide is one of its several disintegrating or katabolic products. These two constituents are not only always present in metabolic processes, but are of such prime importance to the process that a quantitative determination of either or both is a fair measure of metabolism itself." . . . Quoted from article on Truancy, *Ped. Sem.*, Vol. V, No. 3, p. 383. See same article for literature on the relation of O to CO_2 in life processes, also Howell's American Text-book of Physiology for criticisms on the constancy of the ratio of the oxygen absorbed to carbon dioxide produced.

² It is not the purpose to determine the absolute amount of metabolism, such a task is some distance ahead present laboratory methods. The object here is to estimate the relative amounts at different temperatures, and regard these quantities as merely indices to what the absolute quantity may be at a given temperature.

³ The apparatus consisted of a three mouthed glass jar, capacity seven liters. The jar was connected on one side with U tubing and a gas meter—the tubing was filled with pumice stone and concentrated sulphuric acid—and on the other with a series of seven U

TABLE I.
Showing the amount of CO_2 produced per hour per kilogram of Tadpole at different temperatures.

Experi- ment.	No. of tadpoles.	Time.	Air aspirated.	Weight of tadpoles in grammes.	Volumetric portion of CO_2 exhaled	Gravimetric portion of CO_2 exhaled	Weight of CO_2 pro- duced per hour.	Weight of CO_2 produced per hour per kilo- gram of animal.	Tempera- ture Centi- grade.
No. 1,	10	5 hrs.	45.88 Liters.	91 G	.225 G	.1955 G	.08410 G	.924 Grams.	20°
" 2,	10	5½ "	43.7 "	93 G	.015 G	.1789 G	.03875 G	.416 "	7°-8°
" 3,	10	5 "	43.14 "	98 G	.195 G	.2041 G	.07982 G	.814 "	15°
" 4,	10	4½ "	65.71 "	98 G	.075 G	.2105 G	.06063 G	.71 "	26°-27°
" 5,	10	4½ "	67.93 "	97 G	.120 G	.2074 G	.0770 G	.793 "	30°
" 6,	10	5 "	60.64 "	88 G	.180 G	.1980 G	.0756 G	.859 "	22°

¹ The tadpoles were in a high state of feeding, and undergoing rapid metamorphosing. Chapman and Brubaker have shown that in the case of two pigeons, one, fat and well fed, produced per hour twice as much CO_2 as the second, poorly fed and lean in flesh. Further, Richet—Archiv. de Phys. Normale et Pathologique, 5th ser., Vol. II, pp. 17-30, 1890—has shown that in the same species the quantity of CO_2 exhaled is inversely proportioned to the body weight and directly proportioned to the body surface. In the above calculations the weight of ten tadpoles is treated in the calculations as though it were the weight of a single animal. It is evident that when the sum of the body weights of any two animals equals that of a third animal, their body surface is much larger and according to Richet's law exhale more CO_2 than a single animal of equal weight. To illustrate: Take the weight of the ten tadpoles of experiment and regard it as the weight of one animal, the body surface would be 226.24 sq. cm., but regarded as the weight of ten animals of the same species the body surface equals 470.4 sq. cm., or twice the area of a single animal of that weight. It is evident that a plus correction for body weight might properly be made and thus lower the amount of CO_2 exhaled per kilo. of animal.

portion,"¹ and that found in the latter the "gravimetric portion." The sum of the two being the whole amount exhaled. A detailed statement of the experiment and results are given in Table I. This Table shows that a maximum amount of CO_2 is produced at the optimum, 20°C , and that the amounts decrease for temperatures above and below the optimum and further that the fall is much more rapid toward the lower temperatures than toward the higher ones. [See Curve in Chart II.] If then we regard the production of CO_2 as a fair index of the amount of normal metabolism in an organism we are justified in the conclusion that for this species of embryos, maximum metabolism is coincident and very probably a function of optimum temperature. Page's² experiments on the dog show that a minimum amount of CO_2 is produced in a temperature of 25°C and that the amount increases above and below 25°C , which is probably about the optimum for this mammal. [See Curve in Chart II.] Thus the warm³ blooded animal presents reverse conditions.⁴ The fact emphasized here, however, is

tubes and a large Waulff flask. The first and seventh tube contained concentrated sulphuric acid and pumice stone, the first caught any organic matter issuing from the jar containing the tadpoles, the seventh caught organic and moist particles coming from the Waulff flask at times of a negative pressure, the remaining five tubes contained potassium hydrate slightly moistened. The difference in the weight of these tubes thoroughly dried and corked, before and after the aspiration is the weight (with one correction) of the CO_2 that escaped from the water.

The estimation of the amount of CO_2 that remained behind in the water was made by the quantitative method devised by Pettenkorfer, (For description see Fresenius, Quant. Anal., Amer. Ed., p. 834.)

¹The water to be tested was siphoned from the jar into a 100cc burette and from thence into a bottle corked with ground glass. The CO_2 of the air in the room and of the water used was deducted from the sum of the "volumetric" and "gravimetric" portions. The air aspirated was corrected for temperature and pressure. The CO_2 in the room was determined by both the Lunge and Regnault methods. The CO_2 of the tap water was determined by the Pettenkorfer method.

²Page: External temperature affecting the amount of CO_2 , Jour. of Phys., Vol. II, p. 228, 1879-80.

³Body temperature of warm blooded animals is kept constant by all parts of the body being constantly oxidized, so that when the external temperature is low much burning is needed to maintain the requisite temperature, and consequently much carbon produced; also if the external temperature is above that of the body it hastens oxidation. That the relative amounts of CO_2 produced at any temperature below the optimum for cold blooded animals should bear a direct proportion to that temperature is evident, but why the amount should decrease above the optimum is not so clear. It is suggested that probably the higher temperatures destroy or disorganize the normal physico-chemic life processes, since the heat rigor of tadpoles is reached at $34^\circ-35^\circ\text{C}$.

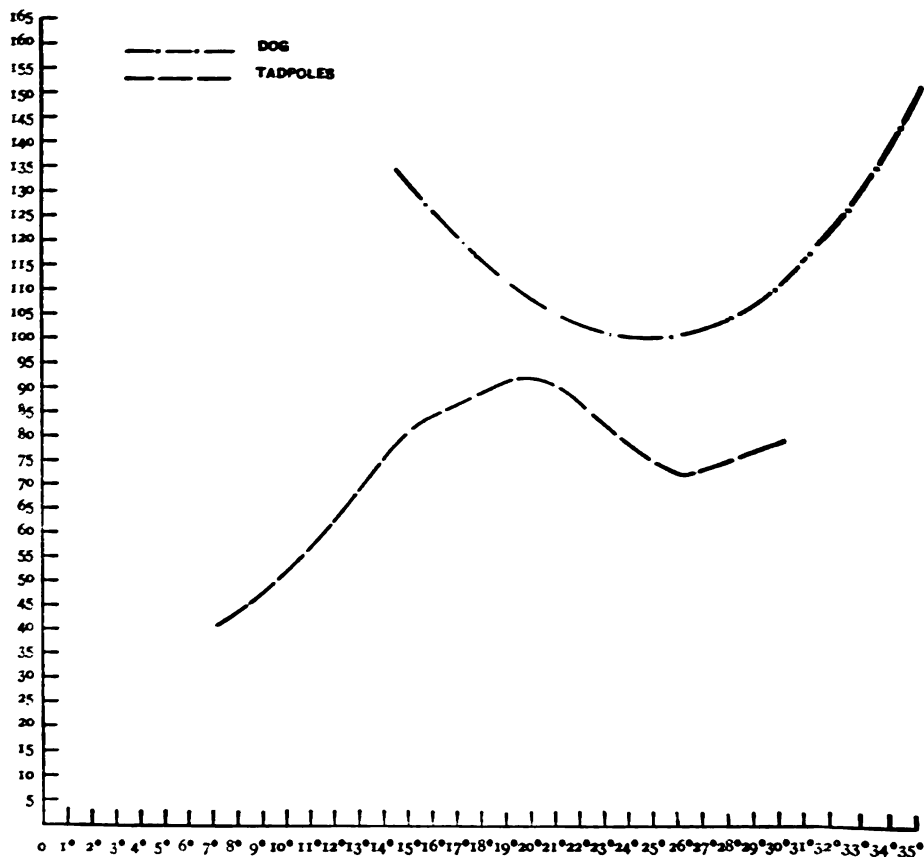
⁴Edward Smith shows that the quantity of CO_2 given off in man is inverse as the change of the temperature; the vital changes lessening with increase of temperature. Food, p. 11.

that there is a comparatively *fixed rate* of metabolism in optimum temperature for both species.

The next question of importance is, what effect has maximum

CHART II.

Curves showing the relation of the production of CO_2 at different temperatures for dog and tadpole.



metabolism on the tadpole, as a whole? To secure experimental evidence on this point a group of ten tadpoles was subjected to their optimum for two months. A second group of

10 were kept in a temperature¹ varying from 6°-8°c below their optimum the first month and 4°-7°c below the second. The results are given in table II, which show that the tadpoles enjoying their optimum increase more rapidly in both weight and length.²

It appears then that optimum temperature, maximum metabolism and most rapid growth are causally related; another

TABLE II.

Showing the rate of growth of ten tadpoles in their optimum temperature, and of ten others in 4°c.-8°c. below the optimum.

Date.	In Optimum.				Below Optimum.				Difference of Increase.	
	Wt.	Gain.	Length.	Gain.	Weight.	Gain.	Length.	Gain.	Wt.	Length
Nov. 28, 1896.	39 Grs.	—	7.11 cm.	—	38.5 Grs.	—	6.81 cm.	—	—	—
Dec. 26, 1896.	45 " 6 Grs.		7.57 "	.46 cm.	43 " 4.5 G.		7.16 "	.35 cm.	1.5 Grs.	.11 cm.
Jan. 26, 1897.	50.2 " 5.2 "		7.88 "	.31 cm.	47 " 4 "		7.41 "	.25 "	12 "	.06 "

inference is, that the optimum is chosen because that particular temperature is a factor in the organism's well-being, that it affords just that temperature stimulus necessary to set agoing the physico-chemical activities in harmony with that pitch or rhythm which natural selection has determined for that species. The same interpretation, in the absence of conflicting evidence, may be extended to all thermotactic organisms, *i. e.*, a positive thermotactic response is an effort of the organism, guided by the "differences in the intensity of heat to which the two poles

¹ Two glass jars of same shape and size were used. They contained equal quantities of tap water into which was put same kind and as near as possible equal amounts of grasses and foods. The jar, in which it was desired to keep a known and constant temperature, was placed in a copper kettle containing on an average nine liters of water. The bottom of the glass jar barely touched the surface of the water. In this way the temperature of the water in the jar was maintained between 20°c-23°c. The temperature of the second jar varied with that of the room, which during the months through which the experiment extended fluctuated between 12°-18°c. The experiment was extended through the months of February and March, but serious and frequent mishaps set in that rendered the results worthless. Although the experiment ran smoothly during the months reported, the force of the results is weakened by the short period of the experiment.

² Drs. Davenport and Castle report tadpoles as growing more rapidly under constant temperature of 24°-25°, then those subjected to 15°c. The results of my experiment had been described some time before their work came into my hands.

of the body are subjected," to seek a temperature, in agreement with its physico-chemical constitution.¹

Malling-Hansen's² discoveries of the intimate relation between temperature and growth of man are quite pertinent to our present problem. He demonstrates a rhythmic response of growth in both weight and height to the large and small portions of the sun's corona as they are successively presented to us by the sun's $27\frac{1}{3}$ days' rotation. The greatest height of the growth curve is coincident with the time in which the larger sector is presented, as this recedes, thus lessening the output of solar heat toward us, the curve falls, but rises again, though not so high, when the small sector of the corona is turned on us. That is, there are two waves of the growth curve comprehended within about $27\frac{1}{3}$ day period, which waves are coincident with the earthward appearance of the large and small sectors of the corona. This is interpreted as a delicate cosmical adjustment of life to temperature.

Enough has been said of only one of the cosmic factors to illustrate its delicate adjustment with life. But it is difficult to see, even though we were to consider every possible cosmic factor from the same point of view, how they have been effective in either bodily or psychic differentiation until we consider some of the inherent properties of protoplasm itself.

How does it conduct itself along the narrow path marked out by cosmic forces? The laboratory attempts to answer the question, in part, by experimentation which aims to test the capacity of protoplasm for acclimatization.³ These experiments include acclimatization to⁴ chemical agents,⁵ to 'desiccation,'⁶ temperature,⁷ changes⁸ in food, etc. The general verdict is that protoplasm is *automatic adjustable*, that it *husbands*, and *profits* by its *experience* within its *milieu*. It appears that the teachableness and the ability to profit by it are among the chief distinguishing features of protoplasm. In fact the history of morphology, of adaptation, of evolution itself is writ

¹ "It (protoplasm) is highly sensitive to changes in temperature migrating if possible so as to keep in the temperature to which it is already attuned." Davenport, *Experimental Morphology*, p. 263.

² Malling-Hansen: *Perioden im Gewicht der Kinder und in der Sannwärme*, Copenhagen, 1896.

³ Davenport, C. B.: *loc. cit.*, pp. 27-32; 65; 85-88; and 249-58.

⁴ Sewall, Henry: *Experiments on the Preventive Inoculation of Rattlesnake*, *Jour. of Physiol.*, Vol. VIII, pp. 203-210, 1887.

⁵ Loew, O.: *Ueber den Verschiedenen Resesturf graill im Protoplasm Arch. f. d. ges. Physiol.*, Vol. XXXV, pp. 509-516, 1885.

⁶ Lance, M. Denis: *Sur la reviviscence des Jardigre des comp. Rend.*, Vol. CXVIII, pp. 817-818, 1894.

⁷ Mendelssohn: *loc. cit.*

⁸ Semper: *Animal Life*, p. 133.

⁹ Davenport, C. B.: *loc. cit.*, pp. 253-254.

large with the effort of life to secure the completest adjustment possible both on the bodily and psychic sides.

The delicate adjustment between life and cosmic forces, the continual effort of life to maintain this adjustment, on the one hand, and the rhythmical, periodical manifestation of the migrating instinct *par excellence* on the other, suggest the importance of considering the mode or nature of the interaction between life and external forces.

According to Fiske¹ and Spencer² all cosmic forces obey a rhythmical motion which is a corollary from the persistence of force.

We may reasonably assume that the primitive *megazoon* found itself in this maze of cosmical rhythms. Heat, light, sound, wind, electricity, etc., beat upon these primordial creatures in rhythmic waves. We may imagine that one of the first tasks of this life was to get in rapport with these innumerable cosmic movements.

In fact existence, survival itself, and the evolution of the organism were conditioned largely on a rhythmical adjustment to the inorganic forces of creation. "Those³ spontaneous compounds whose internal rhythms chance to accord with the external rhythm enjoy the greater probability of survival and thus rhythmic interaction between the internal and the external may be developed through the exclusion of the non-rhythmic, elimination of the ill-rhythmic and the preservation of the duly rhythmic." What is this adjustment but a continual effort of life functions to operate in unison with cosmic rhythms. Accordingly we find rhythms prevailing through all life processes both physiological and psychical.

The elaboration and assimilation of food into the body tissue in excess of waste and repair is rhythmical, that is to say,⁴ growth obeys this law. The 'menstrual life is associated with a well-marked wave of vital energy which manifests itself in the temperature of the body, in the pulse rate, etc., etc. These several phenomena have a striking coincidence to both the lunar period and sun's rotation. The 'pulse shows an annual rhythm maximum in winter and minimum in summer. The daily bodily⁷ temperature is higher in the evening than that of the morning. The return of zymotic diseases in some countries show a remarkable regularity and appear to stand in

¹ Fiske, John: Outline of Cosmic Philosophy, Vol. I, pp. 297-313.

² Spencer, H.: First Principles, pp. 256-257.

³ McGee, W. J.: Earth the Home of Man, p. 5.

⁴ Malling—Hansen: *loc. cit.*

⁵ Stephenson, Wm.: Am. Jour. Obstet., Vol. XV, 1882, pp. 283-294.

⁶ Coste F. H. Perry: Nature, Vol. XLIV, 1881, p. 35.

⁷ Bucknill and Tuke: Psychological Medicine, 4th Ed., p. 317.

causal connection with certain climatic elements. In India,¹ for example, the fluctuations of the death rate by fever coincide with the variations in the range of temperature.

That these innumerable cosmical and physiological rhythms have greatly influenced the soul and have stamped upon it highly colored rhythmical activities are evidenced in every period and condition of human history, in every field of human thought and feeling.² It is manifested among primitive peoples by the readiness and completeness with which they surrender themselves to music and dancing, by their strict observance of annual festivals and celebrations.

The early mind was impressed by this universal principle. Their gods and demons did things rhythmically. They visited the earth, made war and peace, and discharged their herculean tasks for the most part with strict periodicity.³

Spencer has pointed out that philosophic thought obeys this principle. Now Platonic idealism is all-pervading, now the materialism of a Hobbes, then the ebb of Hegelian idealism gives way to the flow of materialism of the third quarter of this century.

Further, our volitional nature pulsates rhythmically. Marriages⁴ in every country show a more or less periodicity. The time of the year for marrying in different countries is somewhat influenced by custom, religious beliefs, harvest⁵ time and the *return of spring*.

⁶Leffingwell raises the question concerning the influence of spring upon the ratio of legitimate to illegitimate births. "Among human beings is there yet remaining any trace of that instinct which leads birds to mate when winter goes, and which in earlier periods of man's development was perhaps as strong as with other animals?" "If it exists should we find any difference in and out of the marriage relation?" The birth rate of ⁷France, Norway, Sweden, Holland and Italy

¹Hill, A. S.: *Nature*, Vol. XXXVIII, 1888, p. 245.

²The psychological aspect of the subject is treated indirectly in every modern exposition of sound, retinal revelry, fatigue and attention. Bolton has treated the subject directly and especially as it is manifested in music, verse and poetry. *Am. Jour. Psy.*, Vol. VI, pp. 145-238.

³Kelly, W. K.: *Indo-European Traditions and Folk-Lore*.

⁴Farr, Dr. William: *Vital Statistics*, p. 76, London, 1885.

⁵Hill, A. S.: *Nature*, Vol. XXXVIII, p. 245, 1888.

⁶Leffingwell: *Influence of Seasons upon Conduct*, p. 115.

⁷Observations tend to show that the largest number of conceptions in Sweden fall in June; in Holland and France, in May-June; in Spain, Austria and Italy, in May; in Greece, in April. That is, the farther south the earlier the spring and the earlier the conceptions—Mayo-Smith, *Statistics and Sociology*, 1895. In Massachusetts the largest number of marriages is shifting from late fall and the New Year, which prevailed down to 1870, to April and June—Mass. State Board of Health, 1896, p. 731.

show that the ratio of illegitimate births between the spring—summer months and the fall—winter months is greater than the ratio of the legitimate births covering the same period. The ratio of the totals for the countries just named for legitimate births between spring—summer months and fall—winter months is 24 : 23 and for illegitimate births for the same periods the ratio is 26 : 22—pointing to a permanent seasonal influence on the reproductive functions and to the genial effect of spring upon the procreative functions. More striking, however, is the evidence of periodicity in the tendency to those relationships which occasion illegitimate births. Under like conditions the excess of the seasonal ratio of illegitimate births over that of the legitimate is a direct expression of the remnant of that passion implanted in man when pairing in spring time was almost universal. The strength of the reverberation of this passion is inversely to the respect for the prevailing customs, religion and law.

The relation between spring and certain bodily and mental conditions finds emphasis in a large group of phenomena arising from *spring fever* and *ennui*. The following are typical cases of one hundred and twenty received on that subject. (See Syllabus, Rubric XII.)

1. M., 20. Whenever I am afflicted with what I have always called spring fever I feel sleepy and tired and have no ambition to study.
2. F., 19. Feel sleepy, languid, no ambition; strength seems to have left me, and every duty seems a great trouble.
3. F., 17. I have no power of concentration, feel that I must be out of doors all the time, am drowsy and ache all over. Like to sleep—can eat only certain things.
4. M., 25. Was physically weak, or rather inert, so that I could hardly drag one foot after the other and the queerest longings beset me—now for a gust of wind to fan my face, now for an apple (would have given almost anything for an apple once), and then I wished intensely for a swift ride. This fever of queer, delicious lassitude and longing lasted nearly three weeks and during that time I was of practically no use on the farm.
5. F., 16. Felt as though all energy had fled, and that I was such a weak mortal—not fit for this life which needs so much energy and brightness.
6. F., 18. Wanted to sleep, or meditate, or dream the time away. It seemed too much trouble to think, to speak or to act. Some very romantic or thrilling story interested me somewhat, but I soon wearied of it.
7. F., 19. I wanted to lounge around in the open air—never want any one to bother me.
8. F., 17. I feel tired of everything, and that I cannot drag out another day—things are weary, stale, flat and unprofitable.
9. F., 18. Could I only break away and go somewhere by myself where the sun is bright and warm and where I can hear birds singing, find a nice comfortable position and spend my time in day-dreaming, I should be perfectly happy.
10. F., 17. Felt as though there was absolutely no life in me and

that I should go wild if I did not get away from everybody and be alone in the wood or on the water in a quiet bay.

11. F., 22. Lose interest in my work, study is a burden. The feeling is impossible to describe. It is a longing for something, I know not what. Often I have sat quietly and tried to analyze it but cannot.

12. F., 19. I feel dull, drowsy, can't hurry, prefer to drag along as I please. Sometimes I like to walk slowly along some shady path or sit down under a shady tree and dream my life away. I have had a desire to be married and have a home of my own. I think I have planned where it shall be and how furnished, a dozen times. Perhaps it is very foolish; but I do it very often.

13. M., 30. This spring a strong wave of sentiment came over me to see an old chum and sweetheart. I could hardly restrain myself from setting out instantly to see her which would have been a long journey.

14. F., 20. Spring fever affects me most about June or when school closes. Then I have a great longing to skip two years. This longing is connected with love. I expect to have a house of my own at that time, and O! how anxious I am to see that time. It is hard for me to work patiently. I like my studies because they take my mind away from thinking too much about this much desired thing.

15. M., 26. I feel most these impulses as often as once a month, at least. And when school is over the tendency is irresistible. I always rush off somewhere. I feel every year as though so much of student life was becoming unendurable. I must get out and do something. I often feel so in regard to love. It is the Lord of promise. I feel oftentimes as if I had waited long enough, and I must fall in love with and marry somebody.

16. M., —. Physician says: "In my youth I had frequent attacks of ennui, and sometimes desired to break away from home and see the great world, but since blessed by a good wife and daughter and a pleasant home, together with more philosophic views of life which came with age, such feelings have gradually faded away."

Longing in the distance, desire for wider liberties and space, hunger, are often strongest at this period. (100 cases of this group.)

17. F., 38. From the age of 20 to 30 I felt spring fever strongly, longed to see strange sights in other countries, felt myself hemmed in and stifled.

18. F., 19. I have often felt during the spring months as if I would like to find employment among strangers—never desired to go any great distance away from home.

19. M., 22. I longed to be out of doors, and to sit under the trees alone and meditate.

20. F., 19. The feeling of longing in the distance comes over me at this time. I try to think what it is, but I cannot. There seems to be something. I have often thought how I would like to have a family, how I would enjoy taking care of the children.

These cases interest us only so far as they contribute evidence to the proposition that there are still left remnants of instinct feelings interwoven and combined with the reproductive functions that stand in causal relation with the cosmic forces of spring time. To summarize the general and salient characteristics: the majority report a tired, languid, worn-out

feeling; a feeling of lassitude; a restless, trembly nervous feeling; a dull, drowsy, hesitating condition. Many complain of headache, no life or energy left, felt as though the blood had ceased to circulate. The air of the room feels poisonous, stifling and suffocating. They long for fresh air, to get out under the wide sky, to lounge and sleep, to lie on the grass and have bugs and beetles crawl over them, to be let alone, to sit down quietly and read, to sit under a shady tree and be read to, to dream, to meditate, to walk slowly in shady paths, to sit quietly in a boat in some secluded bay. Some become quite anti-social and want to be let alone. They wish to forget work and duty. It is hard to think, to concentrate, to direct the attention. Work is distasteful and unsatisfactory. They lose interest and ambition in the work of the moment, and desire a change.

Others wish to begin life anew, to enter upon some great and uplifting work, to be a good samaritan, to be independent, to make a success of things, to cross swords with the world. Many state that they experience passions of love, desire to be married, day-dream over their future home, how it shall be built, how furnished, and how they will delight to care for the children.

These passions, dreams and fancies do not always pass away as such, but according to statistics already quoted express themselves by increasing the number of marriages and conceptions during the vernal season. Could it be that lassitude, restlessness, the inability to think, to concentrate the attention, so frequently mentioned, are due to the shifting of the main bulk of the metabolic processes from the vegetative to the reproductive functions. The fact that thought processes—especially attention—are associated with increase blood supply to the brain, lends color to the view, that when thought is difficult—in the absence of fatigue and other ordinary causes—an increased blood supply is attracted to the reproductive organs.

A very interesting and instructive correlation exists between the age of the individual and the season of the year in which running away from home occurs. (See Chart III.) From one to eight by far the majority leave during the summer. At four, spring takes the lead of autumn and winter, and continues to increase until the seventeenth. The summer curve begins at eight, to fall gradually until at ten, where it follows closely the autumn and winter curves to the sixteenth year, joining the spring curve at seventeen. The feeble and even height throughout all ages is noteworthy in the winter curve. The same description applies to the autumn curve, save that it is higher at the majority of ages, especially at nine and ten,

where it even rises above the summer curve. These two curves regarded separately contain but little interest, merely showing that all ages behave about alike at these seasons; but when compared with spring and summer they indicate that man, like the rest of organic life, hovers about his hibernating quarters. The spring curve, though interesting even alone, derives additional import by comparison with those of the other seasons. From one to seven the number leaving in spring are about equal to those of autumn and winter. At eight the curve makes a considerable rise, leaving the winter and autumn curves far below. Doubtless the phenomenal rise at this age is associated with the child's love of nature and the varied outdoor activities paramount at this period of childhood. The spring runaway is a reaction against the prison life of winter, together with a strong tendency to revel in the out-door charms of spring. Chart IV shows that the nature curve attains its greatest height from eight to eleven, inclusive. A second and larger rise occurs in the fourteenth year, which continues through three successive years, falling slightly in the fifteenth year.

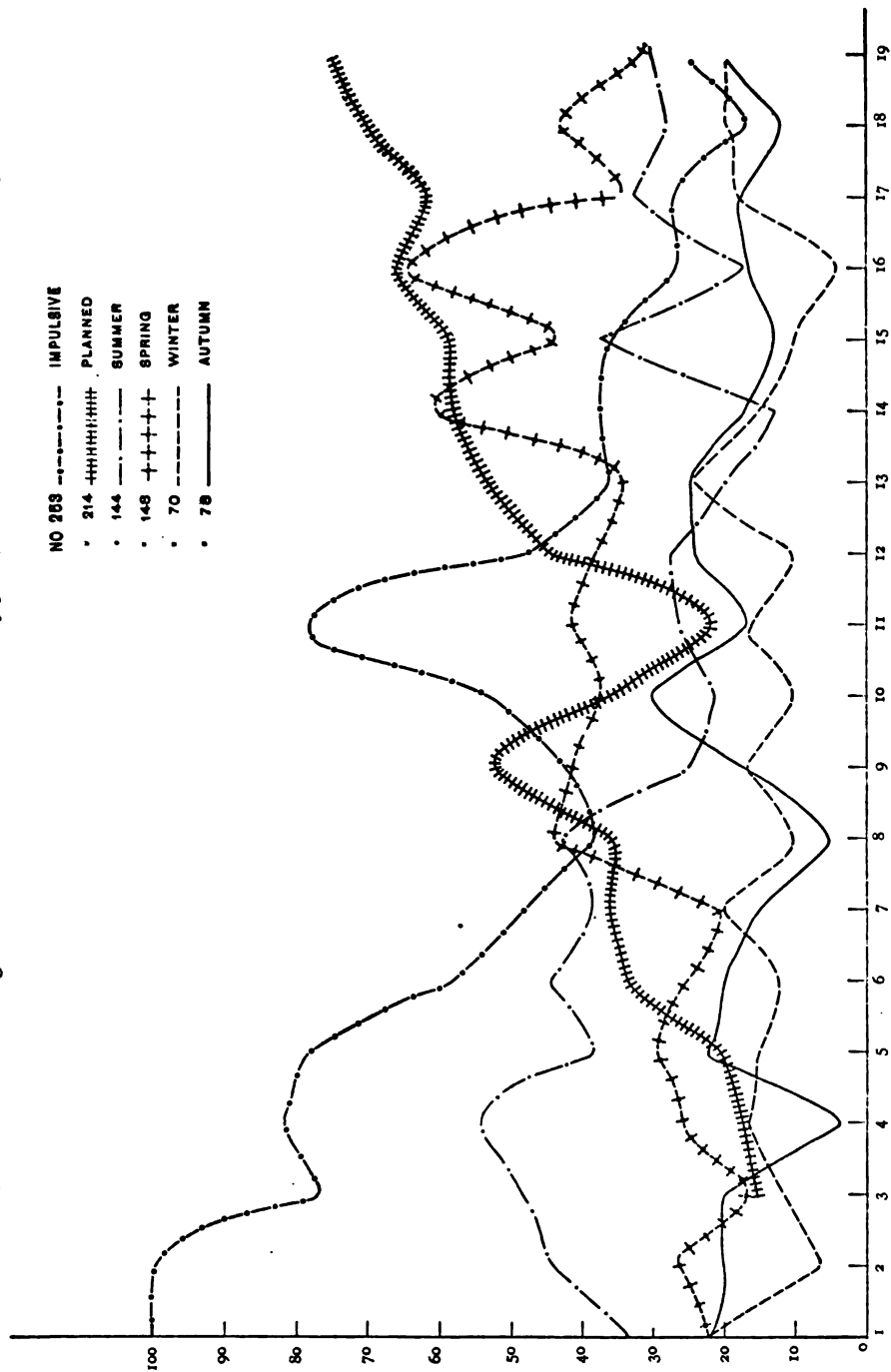
Now from one to twelve years or thereabouts, the child is neuter respecting much that belongs to both primary and secondary sexual differentiation. Up to this time he is a vegetative animal, his activities being determined by atavistic tendencies and by forces that affect the vegetative functions. At about the thirteenth year, however, the physiological¹ changes and peculiar psychosis that take place as a result of the functional development of the reproductive organs expose the organism to a new play of forces that eventually topple the unsettled physiological and psychical elements over into a field of periodic activities recognized as sexual, or as irradiations of these functions.

Considering the data as a whole, that furnished by marriages, spring fever psychosis, and that of the runaways, we are justified in the inference that both youth and manhood up to thirty odd years, are more susceptible to the feelings of sex and its irradiations at that season of the year when the "will to live" is making a universal effort.

Thus far I have tried to develop three general notions: (1) the delicate and vital relation that exists between life and cosmic forces; (2) that the first and most fundamental effort of

¹ For literature on these changes see Ranke: *Grundzüge der Physiologie*, 1881. *Das Volum des Herzens und die Weite der grossen Arterien-Pubertätsentwicklung des Herzens* S 490-94; Lancaster: *Ped. Sem.*, Vol. V, No. 1. *The Psychology and Pedagogy of Adolescence*. Donaldson: *Growth of the Brain*, also Clouston: *Neuroses of Development*.

CHART III. Showing the relation between the season of year, the manner and age of the runaway.



life is to keep in rapport, in attune with cosmic and, I should add, social forces; (3) that as a result of the first two conditions life processes, both psychical and physical, have become rhythmical; and that the higher the organism the more complex the rhythmical adjustment, *e. g.*, the savage must keep in unison with his tribe. He must hunt, dance, fight and celebrate victories with his fellows. The life of the modern man is a web of rhythms; he must not only respond with the rest of creation to cosmic rhythms, but also to the manifold periodicities of civilized life. He must keep in unison with the movements of his trade, with the pulsations of his profession and his society. He must keep step with the fads and whims of his club or drop out.

The thesis maintained here is, that migration is *one* method adopted by an organism to maintain its psycho-physiological activities in attune or rhythm with those of the organic and inorganic world.

It has become a universal mode by which organisms restore and maintain the factors essential to their well-being, be it for light, heat, pressure, food, relation to society, position in trades, profession or what not. It is the mode employed by nomadic¹ societies² to make good the exhaustion and failure of the food supply, by the peasant who comes to America, thereby relieving the pressure of oriental social conditions. The pilgrimages to Rome, Jerusalem and Mecca, are efforts to maintain a more complete adjustment to certain complex religious-sociological customs and rites.

The children's Crusade³ at the beginning of the 13th century is perhaps an illustration of the greatest attempt of a body of human beings to regain peace and well-being to the body and soul by migrating.⁴ Coxey and his army, as others have done elsewhere, embraced the principle to relieve their social and economic strains and stresses. The planomaniac breaks the monotony of the home by daily gadding the street.

¹ Spencer, Herbert: *Synthetic Philosophy*, Chapter on Rhythm.

² McGee, W. J.: *Amer. Anthro.*, Vol. VIII, No. 4, 1895.

³ The history of that period records that war and turmoil were everywhere supreme. Desolation and poverty covered vast districts; starvation entered many homes. Society was disorganized, law and religion a mockery. No time for reading or study,—the densest ignorance settled over the land. In the midst of all this St. Bernard came preaching the failure of the preceding crusades, due to the sinfulness and wanton folly of the pilgrims and soldiers. The Holy Sepulchre must be reclaimed by innocent hands. Who were such? The children of the land: accordingly 20,000 German boys and girls, 10 to 16 years of age, and 30,000 from France at once took up the cause which so soon ended in every form of misery.

⁴ Gray, Geo. Z.: *The Children's Crusade or an Episode of the 13th Century*.

The well-to-do-citizen, and globe-trotter yielding to the popular fashion joins the annual summer wave of European tourists. The American student to hold his place at the crest of his profession feels it necessary to join the semi-pilgrimage to European universities.

SECTION A.

MIGRATION OF ANIMALS.

Wild Animals.

This section embodies in a brief form the observations and theories of naturalists on migrations among lower animals.

CRUSTACEANS. "The adult lobster¹ never moves up and down the coast like the migratory fishes, but is of a far more sedentary disposition." In the spring months of April and May, however, large numbers appear to move from deep water toward the shore. In the fall they retire to deeper water again. This is proven from the fact that they are caught in from three to ten fathoms of water from May until November; for the rest of the year fishing is conducted in thirty-five to forty fathoms. If the spring is late and the water cold the lobster keeps away from the shore. The land crabs of the West Indies² are generally found in great numbers in holes and cavities among the mountains; but every spring they descend in immense bodies to the coast, . . . pursuing so direct a line to the place of their destination that scarcely anything will divert their course. ³"When they have effected the purpose for which they undertook their journey, they slowly return, weak and exhausted; and not long after, millions of the little crabs, which have been hatched on the shore may be seen making their way up to the mountains."

INSECTS. The predatory onslaught of the locusts has been witnessed over all temperate and tropical regions and has quite a place in history. We read in Exodus: "And the locusts went up over all the land of Egypt and rested on all the coasts of Egypt: very grievous were they. . . . For they covered the face of the whole earth, so that the land was darkened; and they did eat every herb of the land, and all the fruit of the trees . . . and there remained not any green thing in the trees, or in the herbs of the field, through all the land of Egypt." Similar descriptions are found in Pliny, Cauch,⁴ Figuiet,⁵ Swainson,⁶ Wallace⁷ and others of this ruth-

¹ Herrick: The American Lobster, p. 20, Washington, D. C., 1895.

² Heilprin: Distribution of Animals, p. 41.

³ Swainson: Habit and Instinct, p. 263.

⁴ Cauch: Illustrations of Instinct, p. 151.

⁵ Figuiet: The Insect World, p. 302.

⁶ Swainson: *loc. cit.*

⁷ Wallace, A. R.: Geographical Distribution of Animals, Vol. I, p. 32, 1876.

less reaper of all kinds of foliage whatever. Such expressions as the following are used in attempting to express their numbers: "Such was its density that when they flew low one person could not see another at the distance of twenty paces." "It totally intercepted the solar light." "Like a shower of snow, when the flakes are carried obliquely by the wind." Mr. Barrow describes a migration of locusts of Southern Africa in 1797. They literally covered an area of nearly 2,000 square miles. When driven into the sea by a northwest wind they formed upon the shore for fifty miles, a bank three or four feet high; and when the wind was southeast, the stench was so powerful as to be smelt at the distance of 15 miles. Their movements are always with the wind, sometimes preceding a strong wind. The same is true of the well known dragon-fly "storms" of South America. Their migrations, like many other insects, never occur at stated times and seasons as those of higher animals, but depend on various *concurrent* causes; as the humidity of the preceding season, the intensity and direction of the wind, barometric pressure and food supply.¹ Hudson says: "The cause of the flight is probably dynamical, affecting the insects with a sudden panic and compelling them to rush away before the approaching tempest. The mystery is that they should fly from the wind before it reaches them, and yet travel in the same direction with it." I venture to suggest that their sudden appearance from five to fifteen minutes before the wind storm is due to the well known barometric² rise preceding wind and thunder storms.

³On the other hand the migrations of several species of butterflies and the nuptial flights of ants obey seasonal and climatic influences. Butterflies (notably the painted lady) fly in huge numbers in France, England, Italy, Switzerland and

¹ Hudson, W. H.: The Naturalist in La Plata, pp. 130-134.

² Davis, W. M.: Elementary Meteorology, 1894, p. 250.

³ Cauch cites several instances of sultry, moist, warm weather interrupted occasionally with showers and thunder storms which were also periods of wave movements of the dragon-fly. "As to the great multiplication of these insects about the end of May in the present year, it is by no means mysterious. From the beginning of that month to the 21st, the weather had been exceedingly rainy; rivers and lakes overflowed and spread their inundations over immense areas of low grounds, whereby myriads of the pupae of the *Libellulae*, which under other circumstances, would have remained in deep water and become the prey of their many enemies, were brought into shallow water; and the hot weather from May 21st to May 29th converted those shallows into true hot beds. Numerous thunderstorms (at Weimer there were four) during that week must have greatly encouraged their rapid development into perfect insects; and so those clouds of winged insects rose almost at once from the temporary swamps and were *immediately obliged to migrate in order to satisfy their appetite as these species are very voracious.*"

Brazil. In the European countries their flight is from south to north during the spring and summer months. In Brazil their movements are from north to south, or from northwest to southeast. They are usually from the dry arid districts of the interior toward the verdant forests of the sea coast during May—June. "We could mention many facts tending to favor the opinion that all these butterfly migrations are made toward these verdant tracts, for the purpose of breeding or rather of depositing their eggs." Huber has associated special climatic conditions with the nuptial flights of insects. "Let¹ us retire to a meadow on a fine summer's day at a time when they first make use of their wings." "Ants² are now and then induced to change their residence. Should it be too much in the shade, too humid, too exposed to the attacks of passeng-ers, or too contiguous to an enemy's quarters . . . they leave it to lay the foundations of another. This I have denominated migration." "During these flights impregnation occurs, and their wings are shed after alighting."

FISH. Their migrations are variously classified: in time; they are either regular, *i. e.*, seasonal, or irregular, many species of the anadromous fishes furnish examples of seasonal migration, long and irregular absences of the bluefish and chub mackerel from our shores represent the latter: In direction, it may be said that they migrate roughly in three planes: (1) a horizontal plane extending toward or from the equator—such movements are largely controlled by temperative conditions; (2) a plane at right angles to the first, to or from the shores, caused by the fish seeking a stratum of water of an agreeable temperature, and also by the stimulus of the spawning season. Ichthyologists are now of the opinion that movements in this plane constitute the great majority of their migrations; (3) a vertical plane to which Goode³ has given the name "bathic migrations." Such movements are controlled by temperature, winds, currents and light. It is generally thought that the causes of these several movements are due to changes in temperature, a desire for suitable places for spawning and to search for food. Winds, currents, light and density of the water are also regarded as minor factors.

The most potent of these factors, however, is temperature. I shall enumerate only a few of the best confirmed observations.

Temperature. The optimum temperature for the menhaden is 60°–70° Fahrenheit, that of the herring is 45°–55° Fahrenheit. The former is a warm, the latter a cold-water species.

¹ Huber: *Ants*, p. 96.

² Cauch: *loc. cit.*, pp. 148-152.

³ Goode, G. Brown: *U. S. Report, Fish and Fisheries*, p. 51, 1877.

Accordingly,¹ when the menhaden desert the Gulf of Maine they are replaced by the herring. Cold weather drives the menhaden to the warm strata (bathic migrations), while it brings the herring to the surface. The relation between the distribution of herring and the degree of heat in the water has an important bearing upon the herring fisheries; "since," when the heat of the surface water is above 55°F. herring are seldom seen; as this decreases they make their appearance. This is so well established that now the herring fishery on the coast of Scotland is largely regulated by the temperature observed, and when it is decidedly above 55° the herring are not looked for." The² extent of the catch of anchovies along the shores of Scotland during the fishing season is (at least largely) dependent on the temperature of the water during the mid-summer months of the preceding year.

Search for Food. Baird observes that oceanic currents have a more or less influence upon the distribution of fishes. This, however, depends more upon their pursuit of the less independent algæ, jelly-fish, crustaceans, ascidians, etc., that float hither and thither with the currents. Prof. Möbius (quoted by Beard), in investigating the food of the herring in the German seas finds that the abundance of herring in any one season is in strict proportion to that of the shrimp. A direct and combined effect of food and temperature upon fish movements is found in San Francisco Bay. This bay receives the waters of two very large rivers, which bring down constantly a large amount of minute animal and vegetable life, much of which finds a congenial home in the bay, thus furnishing a large and varied quantity of food for its fish life. The temperature of the bay is almost constant, varying only a few degrees at any season of the year. The constancy of these two most important factors (food and temperature) throughout the year ought to reduce migrations to a minimum. Observations confirm this supposition.⁴ The official report reads: "That the conditions are extremely favorable to the support of aquatic life is demonstrated in the rapid increase and *permanent residence* (italics mine) of the several fine food-fishes introduced from the Atlantic coast by the government. Some of the fishes thus acclimatized are naturally anadromous, but in San Francisco Bay, contrary to their usual migratory habits, they do not appear to have any desire to spend much, if any, of their ex-

¹ Goode, G. Brown: U. S. Fish Com. Report, p. 72, 1877.

² Baird, Spencer F.: U. S. Fish Com. Report, p. 55, 1886.

³ Bottemanne, C. J.: p. 340, Vol. I, Jour. Marine Biolog. Ass'n.

⁴ Wilcox, W. A.: Fisheries of the Pacific Coast, U. S. Fish Com. Report, 1893.

istence in the ocean." Another¹ example of the sufficiency of food and limited range of temperature checking the wandering of fish is furnished by the menhaden that may be found at all seasons of the year along the coasts of Ga. and S. C. Only a partial migration occurs in mid-winter, which is now believed to extend only a short distance seaward.

Wind, Light, etc. Herr von Freedom (quoted by Goode) finds that warm winds and clear skies of the North German seas are coincident with large catches, and *vice versa*.² "A bright sunny day," says Baird, "will frequently call up forms that are never seen at any other time, while others, again, only approach the surface on cloudy days, or even in the night, exclusively." Experts testify that along the shores of Scotland thunder storms of some magnitude and extent affect seriously the quantity of the catch on the following day. If any are caught, it is at extreme depths.

Movements Affected by Enemies. Salmon are known to entirely abandon a particular section of sea coast by the onslaughts of the white whales and porpoises. In³ the fall of '94, owing to the vast numbers of bluefish and squeteague (deadly enemies of the menhaden) in the vicinity of Montauk Point, large schools of menhaden were detained in Gardiner and Neapeague bays weeks beyond their usual time of departure, and were unable to reach the ocean until their enemies had left. About October 21st the bluefish disappeared, and the departure of the menhaden rapidly ensued. In fact, so great is the fear of the menhaden for the bluefish—a veritable corsair—that the former are known to reverse the course of their annual migrations for several weeks should the latter appear in their front.

Reproductive Instinct. The movements associated with the reproductive period give the clearest evidence of a migrating instinct. Moving from an uncomfortable to a comfortable temperature, seeking light of proper intensity, pursuing and capturing prey are activities of the more simple, reflex type—a reaction to a simple stimulus. True, migrating movements are in obedience to stimulus, but a stimulus of a very *complex* sort, it is *periodic* and *persistent* leading to the execution of large and definite tasks, impelling⁴ the species to a particular spot at a fixed time. They are performances larger than individual ex-

¹U. S. Fish Com. Report, p. 40, 1877.

²Baird, S. F.: *loc. cit.*, p. 57, 1886.

³Smith, H. M.: Bulletin of U. S. Com., 1895, p. 299.

⁴The long journeys of catadromous fish give unmistakable evidence of an inherited activity ("primary automatic" by some authors, "congenital" by others). "This species of fish, represented by the eel, are born in the sea, ascend the rivers and reach their maturity in two to four years, and then, when mature, descend to the ocean to spawn, and possibly never leave it again."

perience, and too clear-cut and purposive to be ascribed to immediate sense experience. As sexual maturity approaches the stimulus, which has its origin in the developing reproductive organs, urges it to leave the ocean and, entering the mouth of a river, to journey upward, often thousands of miles, to its source in the mountains. Classical examples of this sort are the seasonal migrations of the¹ salmon,² tunny³ herring,⁴ shad and sturgeon up rivers or into quiet estuaries for the purpose of spawning.

BIRDS. The mystery⁵ and superstition that has hovered about bird movements are dissolving before sober and careful observation. The problem is by no means solved, but it has been brought from the region of folk-lore⁶ and the mere "wonder" stage⁷ and given a seat alongside other unsolved problems as anger, hunger, fear, etc. True, the progress for the past twenty years has been so feeble and unsatisfactory that some scientists⁸ discourage theoretical speculations on the subject, regarding them not only useless, but a positive injury to real observations of nature. Despite these backward conditions two groups of theories are set forth. To the first group I have applied for the want of a better term *kinetogenetic*, and to the second group *physiogenetic*; meaning by the former such theories as make food, geological, and the several climatological elements the effective causes in originating the instinct, by the second, the periodic physico-chemical processes that are coincident with the reproductive and moulting seasons.

Kinetogenetic. Faber (quoted by Homeyer) says: "That nature divided every individual into two irresistible impulses; the wandering impulse (*wanderungstrieb*), and the homesick impulse (*heimwehtrieb*).⁹" The bird shows the former when it leaves the place of its nativity and repairs to a region usually

¹ Romanes: *Animal Intelligence*, p. 294.

² "At this time the king of fishes (salmon) is in physical perfection, with few rivals in beauty or strength or fierce energy or indomitable courage and perseverance; but its strength is soon fully taxed in surmounting the obstacles and in fighting the rivals which oppose its progress, until at last, worn and thin, torn and mangled by battle, and battered by rocks? and whirlpools? (question marks mine) with its skin in rags, its fins crippled and bleeding, . . . nothing of its kingly nature remains except the indomitable impulse, which no hardships can quench, still urging it upward, until, if any life is left, it at last reaches the breeding-ground." W. K. Brooks, *Pop. Sci. Month*, Vol. LII, 1898, pp. 784-85. (Prof. Brooks's article appeared after this section had been written.)

³ Swainson: *loc. cit.*, p. 263.

⁴ Wallace, A. R.: *Geographical Distribution of Animals*, p. 19, 1876.

⁵ Newton: *Birds*, *Ency. Britannica*.

⁶ Wallace, A. R.: *loc. cit.*, p. 21.

⁷ Brooks, W. K.: *loc. cit.*, p. 786.

⁸ Homeyer, E. F.: *Die Wanderungen Der Vögel*, Leipzig, 1881.

characterized by new foods and climatic elements, the latter by its return after a season to its birthplace.

Darwin's theory is that the ancestors of migratory animals were annually driven by cold or want of food, to travel slowly southwards, . . . and that this compulsory travelling would become an instinctive passion.

Palmèn¹ undertook in 1876 to verify Darwin's theory from the study of geological history. He worked out in detail nine great routes traversed by birds in their passage from Greenland and northern Eurasia to Africa, southern Asia and the East Indies. A glance at the routes shows that the presence of water in the past and present in the form of rivers, lakes, seas and ocean is the major factor in determining the bends in the course of their flight. These routes pertain to bog and water birds. They are quite circuitous, *e. g.*, the most direct route for the crane living on the shores of the Baltic, to its winter home in northern Africa, is across the Alps and along the east shore of Italy. Its actual route is up the Rhine to near its source, and down the Rhone to the sea, and then along the west shore of Italy and Sicily across to Africa. The most direct route for the wagtail from Greenland to a warmer climate is along the eastern coast of North America, instead of this it strikes boldly out to the S. E., across the Atlantic toward the shores of Norway and the British Isles. Ornithologists are agreed that most of our eastern birds come to us through Mexico, and in returning to their winter homes in Central America, they travel through Texas and Mexico, and are unknown in Florida and the West Indies.² Others have come to us through Florida, and in returning to their winter quarters do not pass through either Texas or Mexico. This is best illustrated by the bobolink, an eastern bird, which breeding from New Jersey northward to Nova Scotia, has spread westward until it has reached Utah and northern Montana. But, and here is the interesting point, these birds of the far west do not follow their neighbors and migrate southward through the Great Basin into Mexico, but . . . retrace their steps and leave the United States by the roundabout way of Florida, crossing thence to Cuba, Jamaica and Yucatan, and wintering south of the Amazon." While in some cases the relation of the route to the conditions for procuring food is clearly evident, in species like the wagtail, eiderduck and bobolink, no such relation exist at present. This fact brings to the front the permanency of the routes, and fully justifies the inference that not only the impulse to migrate, but also the direction, is an inherited tendency.

¹ Palmèn, J. A.: Die Zugstrassen der Vögel, Leipzig, 1876.

² Chapman, F. M.: Bird Life, Appleton, 1898.

The bobolink of Utah did not learn their route in one generation; they, in all probability, inherit the experience of countless generations, slowly acquired as the species extended its range westward. But how shall we account for the eiderduck, the wag-tail and puffin, wholly disregarding land forms in a portion of their route, and faithfully following them in others. Weismann, Darwin, Palmèn and others, believe that these routes are older than the present topographical conditions, that what is now sea¹ was land in a past geological age, furnishing way stations of food just as the littoral and fluvial routes do at the present time.

The study of route migration emphasizes two things, (1) that the migrating impulse is, at least, partly inherited. (2) That its antiquity dates back to former geological periods. It has also directed the attention of the movements of single species, and given hints on the relation of bird movements to food, but it does not account for the *origin* of the vast movements. Allen,² Spencer,³ Darwin⁴ and others say in substance, that the instinct grew out of a series of freezings and thawings of the glacial epochs, that bird life must have been crowded southward, and the struggle for life thereby greatly intensified. The less yielding forms may have become extinct; those less sensitive to climatic changes would seek to extend their range by a slight removal northward during the middle intervals of summer, only, however, to be forced back again by the recurrence of winter. These incipient migrations must have been gradually extended and strengthened as the cold wave receded, and opened up a wider area within which existence in summer became possible. What was at first a forced migration would become habitual, and through the heredity of habit give rise to

¹ This may be illustrated by the route taken by the crane and eiderduck from the mouth of the river Rhone to the shores of Africa. Instead of striking directly across the sea from the Rhone, they pass along the west coast of Italy, via Sicily, and from thence to Africa. It is pretty well established that the Mediterranean Sea was divided into two halves by an isthmus between Sicily and Africa, which birds followed in their migration north and south. This strip of land began to sink gradually, the flat places becoming bogs, and later so many little straits, the higher places would form a chain of islands, Sicily being the last surviving link in the chain. These bogs and islands instead of inducing the birds to change their course would, if anything, rather tend to strengthen their preference for it on account of the variety and quantity of food furnished by such land forms. So that by the time of a complete submergence the inherited tendency for this particular route would have become so strong that it impelled them to cross this vast sheet of water.

² Allen, A. J.: Scribner's Month., Vol. XXII, pp. 932-938, 1881; also Bulletin, Nuttall Ornith. Club, Vol. V, 1880.

³ Spencer: Prin. Biology, p. 412.

⁴ Darwin: Origin of Species, p. 342.

the instinct. Temperature and food are the principal factors in this theory.

The metabolism of the bird exceeds that of all other vertebrates. This calls for abundant and nutritious food, and especially during the breeding season. So vital is this relation that Wallace is disposed to regard the migrating instinct—"as¹ an exaggeration of a habit common to all locomotive animals of moving about in search of food." Indeed Hudson² has found that abundance of food may change the time of the breeding season.

³ "In the island of Goree the swallows remain through the whole year because the warmth of the climate enables them to find food at all seasons." Allen⁴ has shown that the distance traversed by the migratory kind in passing from their summer to their winter homes is in direct relation to their habits in respect to food. Yet while the effect of food upon bird life is direct and vital, it does not explain satisfactorily the periodicity of the impulse, the regularity to a day with which some birds return to their nesting places. In fact it does not account in many cases for the southward movements. The swift⁵ and cuckoo both in America and England leave for the South when nature is in her richest abundance and the temperature fairly constant. Many birds leave their winter homes in the tropics in the height of the tropical spring when insect and vegetable food are daily increasing. They leave a land of plenty for one from which the snows of winter have barely disappeared, often coming so early that unseasonable weather forces them to retreat.

This advancing, checking, stopping suddenly or even retreating temporarily led Prof. Cooke⁶ to study the relation between meteorology and migration. His extensive data suggests a correlation between successive "bird wave" or "migration wave" and the "warm waves" in the atmosphere. The investigation was not a complete one and is doubtless subject to errors and corrections.⁷

It seems clear in some cases that temperature exerts a direct influence upon their movements, but it sheds no light upon those very definite migrations that occur in equable temperature and abundance of food, *e. g.*, swift, cuckoo, bobolink. Many East-

¹ Wallace, A. R.: *loc. cit.*, p. 21.

² Hudson, W., H.: *loc. cit.*, p. 63.

³ Ribot, Th.: *Heredity*, p. 16.

⁴ Allen, A. J.: *Scribner's Month.*, *loc. cit.*

⁵ Couch: *loc. cit.*, p. 138.

⁶ Cooke, W. W.: *Report on Bird Migration in the Miss. Valley*, 1884-85.

⁷ A further attempt has been made to represent graphically the migration of birds and the composition of the avi-fauna changing with the season. W. W. Stone, *The Auk*, Vol. VI, p. 139.

ern species move southward not according to temperature changes, but rather with respect to food changes.¹ Wallace and Chapman contribute evidence showing that temperature and weather elements in general have very little to do with the *time* of their arrival or departure. They consider temperature effective only as far as it effects food supply. The Pine Warbler's wide area (16 degrees parallel of latitude) of nidification is a case in point showing that temperature alone is not the factor that determines bird distribution and migration. Again, if food and climatic elements were the sole factors in originating the impulse, the periodic migrations within the tropics would remain mysterious, because, there, these factors are comparatively uniform throughout the year.

Physiogenetic. I think it quite probable, that, if a careful record of a bird's metabolism were kept throughout the year, and expressed graphically, it would show among other things two distinct elevations, a large one at the approach and during the reproductive period, and a smaller one at the moulting season. Facts are not wanting which lend this supposition some degree of certainty.

It is well known that both physiological and mental changes more or less varied, occur in nearly all species from crustaceans to and including species of anthropoid apes, during the procreative period. Darwin² in his thesis of sexual selection presents an immense number of facts on this point, especially on the changes that occur in secondary sexual characteristics. These changes reach their climax in birds. The voice, plumage, comb, wattles and weapons of various sorts are all brought to their greatest possible perfection. These secondary sexual changes are paralleled by more fundamental and important ones in the primary organs before their flight. In³ the case of sea birds dissection shows an enlargement of the sexual organs before their flight — those of the male enlarge first. The deposit of eggs by the trout and salmon soon after their arrival to the spawning areas is evidence of ovarian activity even before migration began. The parturition⁴ of the seal occurs within a day or two after her advent to the rookery. Stork,⁵ geese, and members of the Hirundinae⁶ family display unusual activity previous to their flight.

These periodic "self-assertions" of the reproductive energy induce physico-chemical changes throughout the whole organ-

¹ Newton, Prof.: See article in Ency. Britannica.

² Darwin: *The Descent of Man*, pp. 270-555.

³ Chapman, F. M.: *The Auk*, Vol. XI, 1894, pp. 12-17.

⁴ Elliot, H. W.: *An Arctic Province*, p. 282.

⁵ Swainson: *loc. cit.*, p. 261.

⁶ Cauch: *loc. cit.*, p. 130.

ism, thereby ill-adjusting it to external conditions which before favored and promoted well-being. Influenced by this new development of organs and energy their very nature seems altered ; and while the climate they formerly delighted in has thus grown irritating and irksome, they feel a craving for one in which the procreative impulse may best be carried into effect. Similarly, the "moulting season" works physiological changes of the greatest importance for the individual. If the physico-chemical changes of the procreative period are in the interests of the species, the race, those of the moulting season are for the individual. During this season hens cease to lay, birds quit singing. Naturalists speak of them as "moping." Peafowls hide, courting and love antics cease. Rich¹ food and excited antics are requisite to the moulting process. "This feverish condition is accompanied with a higher degree of sensibility, which renders irksome and aggravating those impressions of the air which before were pleasing. An appetite for new kinds of food may be a natural accompaniment of this state of the body. The moulting process, *per se*, occurs in migratory birds as soon as they complete their southward journey. These considerations point strongly to the conclusion that both the *homeward* and *outward* migrations have a physiological basis, and that these processes serve as a stimulus to the nervous mechanism which discharges in terms, so to speak, of migrations. There are also two other motives associated with the breeding seasons that set in motion almost all forms of life. The first includes all those activities connoted by "sexual selection," the second is the search for suitable breeding areas.

Animals, which are at all other times solitary, including most carnivora, seek the opposite sex of their species during the rutting season. The lion, tiger and the entire family of Feli-dæ, both wild and domestic, lead solitary, selfish, vegetative lives, except during the season of love. The sexes of the arctic reindeer keep apart except at the courting season. The same is true of the wild turkey,² the grouse, and certain vultures of the U. S. The male chaffinches in Sweden never migrate. The females go south in September and return to Sweden in April, where they are fought for to the finish by the males. Pairing, according to Darwin, is effected by the "law of battle." Describing it among birds, he says, "when many males congregate at the same *appointed spot* and fight together, as in the case of grouse and various other birds, they are generally attended by the females which afterwards pair with the victorious combatants." The point urged here is that the desire

¹Brehm, Dr. A. E.: Bird Life, p. 372.

²Darwin : Descent of Man, p. 416, etc.

for a mate or mates brings together periodically great aggregations of life, that otherwise would have met perhaps by chance. May not the desire for a mate and the repeated bodily experiences excited in what was at first accidental meetings and pairings have become permanently associated, so that the desire for a mate is immediately followed by a journey for one, or to the "breeding ground?"

The search for suitable breeding areas, it appears, is prompted by two causes: first, suitable food and shelter for the young; second, the well known desire that so many animals have for seclusion during the reproductive period. In fact nearly every species of the great backbone series will seek at the approach of this season some retired part of their haunts or range in which to bring forth their young. Probably the second desire grew out of the first, especially out of the necessity for shelter for nest, eggs and helpless young.

The female of the reindeer¹ of Norway, of the common stag², of the long-tailed deer of the British Isles, of several species of "monkey"³ isolates herself from her congeners and other forms of life for a fortnight or more during parturition. The annual⁴ return of the seal to her "rookery," at the breeding season is absolutely necessary for the perpetuation of the species. The young seal from the moment of birth to a month or six weeks is utterly unable to swim. Especially is it necessary that birds should select safe breeding grounds, nests, eggs and birdlings are fragile, helpless objects, an easy and tempting prey to enemies. There is no wonder to be attached, then, to the fact that birds above all other creatures are most circumspect⁵ about the location of their breeding sites.

In England the chaffinches and a host of other birds spend the winter in the open country but at the approach of spring come to the gardens, hedgerows and fruit trees because these places offer better security for nesting than the wood or heath. The starling spreads itself over the country of Cornwall in the winter and in the spring immense flocks desert their food area, though only to proceed to the distance of a few miles, for the sake of a place in which to hide their nests. Chapman mentions several species of tropical sea birds that resort each year to some rocky islet, "rookery," where they may nest in safety.

¹ Darwin: *The Descent of Man*, p. 503.

² Swainson: *loc. cit.*, p. 275.

³ Hartman: *Anthropoid Apes*, pp. 247-48.

⁴ Heape, W.: *Philo. Trans.*, Part I, p. 413, 1894.

⁵ Elliot, H. W.: *loc. cit.*, p. 287.

⁶ It is not to be understood that birds are conscious of the superior advantages of these sites any more than they are conscious of the fitness of the materials (grasses, hair, sticks or mud) used in nest building.

These movements are usually regarded as non-migratory, and yet the object is the same, and the migration as regular as that which prompts a wagtail or a puffin to wing its way from the Mediterranean to the arctic regions.

¹ Brehm says: "The act of migration stands in a certain way connected with the business of breeding and moult."

² Wallace has emphasized the necessity of separating the *subsistence* and *breeding* areas making food and safety during the nesting period the causal elements or initiative factors.

These two authors, taken together, correlate the reproductive and moulting processes and the instinct for seclusion with that of migration. To cover the facts of *periodicity*, of all real migrations, the immense *distance*, and *direction* of some of the routes, I should restate and add to the above theories in somewhat this fashion: *The incipient factors in originating the migrating instinct are the COINCIDENCES of the physico-chemical changes and the instinctive desire for seclusion and for suitable breeding areas with the periodicity of the seasons.* If it had happened that secluded and suitable pairing and breeding grounds had always been selected in an east and west line from their area of "subsistence," it is probable that the powerful instinct as we know it, would never have originated, because the *climatic* and food elements could never have co-operated with the procreative factors; on the other hand it appears as equally improbable that the instinct should have originated in the absence of the desire for seclusion or suitable breeding grounds or the ever recurring physiological changes which mark the annual cycle of bird life.³

This theory explains a number of facts connected with bird migration that are otherwise mysterious.

Males of many species precede the females in the northward journey; this correlates with the male sexual organs developing first. Birds that do not sexually mature the first year in the feeding area either migrate only a small portion of the way or not all. Barren birds of a migratory species remain south all their lives, only at times do they make a portion of the journey—doubtless due to imitation and the social instinct.

¹ Brehm, Dr. A. E.: *loc. cit.*, p. 368.

² Wallace, A. R.: *Nature*, Vol. X, 1874, p. 459.

³ Chapman says—in the *Auk*, Vol. XI, 1894—"It is not improbable that the period of reproduction may have been coincident with the return of the warmer part of the year and in addition to the desire for seclusion and the pressure exerted by the crowded conditions of existence, which then prevailed (during glacial epoch), was potent in inducing birds to seek breeding grounds in the north during the summer. The only criticism offered against this theory is the time (glacial period) and the place (northern zones) it offers for the origin of the instinct. Arboreal tropical life is now believed by naturalists to be the natal home of birds.

The arrival to the breeding ground is much more regular and uniform than their departure, the latter is usually governed by the success of breeding. They come burdened with the great task of procreation which gives instinctive purpose and precision to their movements, they leave in obedience to vegetative functions. The theory accounts for their leaving breeding or feeding area when to all appearances temperature and food are ideal.

LOWER MAMMALS. Omitting the voluminous literature on this topic I shall mention only briefly the more significant facts.

Movements to which the term migration is applicable are seen in ten or twelve species of rodents, certain wolves and bears, several species of rēngulate and a few primates.

Classical examples of the instinct among rodents are the military-like advances of the squirrel, the hare and notably those of the lemming.¹ The movements begin in the spring or fall and may continue during severe weather. The object is apparently to enlarge their food area which is made necessary by an unusual multiplication² of the species and an unfavorable food season.³ "Wolves"⁴ everywhere descend from the mountains to the lowlands in severe weather, and bears not infrequently migrate in great numbers to escape the rigors of an extreme winter.

Porcupines in Persia migrate north and south with the seasonal changes of temperature.

Reindeer and antelope, especially the latter, migrate in some countries as regularly as the fishes and birds,—the females of some species going farther north than the males.

Food, enemies and change of seasons influence the movements of monkeys.

On the whole it appears that, although the movements of the lower mammals are due to the same causes that control animals moving in air or in water, yet they are less precise, definite and periodical. True, unmistakable traces of the instinct are present, manifesting itself in flashes, as it were, sometimes impelling the creatures to destruction, *e. g.*, mouse and lemming.

*Domestic Animals.*⁵

For the sake of completeness, but more particularly for emphasizing certain observations made in the present section and

¹ Romanes: *Mental Evolution in Animals*, p. 282.

² Swainson: *loc. cit.*, p. 250.

³ Heilprin: *Distribution of Animals*, p. 40.

⁴ Wallace, A. R.: *loc. cit.*, p. 18.

⁵ The material presented here is in answer to Rubric XIII of the syllabus. Two hundred and fifty cases were received on ducks, turkeys, chickens, cats, sheep, cows, horses, etc.

Doubtless they will seem very commonplace, so they are, but to

by way of introductory to the love of home, I treat here the migrating and homing phenomena of domestic animals.

FOWLS. 1. "I have observed that animals, such as cats, dogs, hens, hares, cows and horses are attracted to home life, while fish, ducks, turkeys and guineas are not—they like to wander."

2. "Our chickens often wander but are sure to return before night fall, while our turkeys always wander away, and sometimes they stay."

3. "Have known hens and turkeys to stay away during the day and lay their eggs in the fields or woods and come home at night."

4. "A neighbor had a hen that would come *to our place to roost* but always *went home to lay*."

5. "When we kept turkeys they used to wander from home; especially to build nests."

6. "When a hen 'stole her nest,' we found it hard to locate it, because the hen would not go to it when any one was looking."

7. "Have known Mrs. C. to watch her turkeys for two hours at a time to find where they laid. She was often compelled to follow them over a mile away into some underbrush."

The writer has performed the very monotonous juvenile task of following the wanderings of a turkey-hen until she saw fit "to take" her nest. If she detected my watching, her course was most often turned leisurely in the opposite direction, and she would postpone going on for several hours; sometimes, if watched too closely, she would not visit the nest that day. Usually when she "made up her mind" to go, she struck a bee-line for the nest as fast as she could run.

8. "Had given up one of my hens as stolen or killed, when to my surprise one day she entered the yard and presented me a dozen little chicks in a very 'fussy fashion.'"

9. "Have a number of times missed hens and gave them up for lost, but after some time they would come up with a few little chicks."

10. "We gave up keeping turkeys because it was impossible to keep them at home."

11. "It was very hard to keep ducks on the farm, although we had a brook and pond; they were forever gone,—would wander a mile or two below the house staying two or three days, when back they would come—as soon as fed and rested a day, away they would go again."

12. ". . . Sold a couple of ducks to a neighbor three miles away. About a week after a tremendous noise in the yard awoke the household. It proved to be the quacking and gabbling of the ducks. Never before had I seen an animal make so great a display of pleasure."

13. ". . . Drove my young chicks over a week old at evening into a new coop, but left the door open until late, as it was a very warm night. When I returned to shut the door of the new coop, they had all left.

the writer therein lies their value. The naïve innocence, simple-mindedness and freshness with which they are told precludes all suspicion that their observations were influenced by preconceived theories and biological conceptions as to the deeper significance of what they saw.

Going to the old one I found them all cuddled in a heap beside the closed door."¹

CATS. 14. "My cat goes away frequently, stays three or four days perhaps—always glad to see us on his return."

15. "Our cat goes off for two or three days, and then returns. He is treated kindly and well fed, but just roams off, we can expect him within a week."

16. ". . . This cat used to go away every month, and stay about a week, then come back. Its journeys were regular."

17. ". . . Owned a cat that would stay in the woods for three months at a time, she would then return home with four or five kittens."

18. "Had a cat that would take care of her little kittens in an old basket at the next door neighbor's. She brought her kittens over home three times a day to be fed."

19. "When the little kitten of our old cat got big enough to run around we used to play with it a great deal. One day it disappeared. Thorough searching proved in vain. The old cat was around every day, but no kitten. One day the old cat was spied going across the field. I followed. She led me across two large fields to a patch of oats. Went to the edge of them and called. Out came that little kitten as fat as a butter ball. We think the mother hid it because we fondled it too much."

The last six cases are typical of 36 that illustrate a role by the procreative factor in wandering.

20. "Have observed that cats had much rather have one place in which to sleep."

21. "Cats will seldom leave permanently their old home, even after the family has moved away."

22. "When we moved into our new house we left behind a large cat that had been in the family for several years. My father was very fond of the cat. He would go down to the old house with food for the cat, but he would not eat. He howled day and night, but whenever any of us went down to the old place he would jump on us, roll over and purr, and act wildly glad. My father could not bear the idea of its grieving and starving itself to death, so the cat was brought to the new home. He was crazy with joy. He ran up and down stairs, on top of the furniture, rubbed against and smelt of everything, climbed up on us, walking right up our skirts into our arms, remaining but a moment, then down again, and following us about like a dog. After awhile he settled down and went to sleep."

Fifty cases like the last five were received on the home instinct of the cat.

DOGS. The following cases are typical of the wandering and homing instincts of dogs :

23. "Our dog went back to his old home, three miles distant, every Saturday night, and returned every Monday morning regularly."

24. "Owned a dog that was very fond of going off on long journeys by himself. Sometimes he would be gone two or three days, and would come home worn out and in every way ready for rest. After he had stayed home several days he would be ready to start out again."

¹ I have before me numerous observations on the homing of pigeons, but such facts are every-day occurrences, as observations and current literature abundantly testify. The cases are therefore omitted.

25. "Had a dog that would travel a week, then stay at home a week, until finally he disappeared."

26. "Have a dog that persists in running away. Is kept tied, will leave home as soon as untied to go to where there is a dog. He will not go away during the winter."

27. "Know a dog that spends a great part of his time at a neighbor's, although his master is good to him."

28. "Dogs will often go off on journeys lasting two or three days or longer, but will return after that time."

29. "Brother bought a hound from an old man living some miles from our home. The dog returned next day. We went after him a number of times. Even after the old man died the dog would make trips to his old home."

30. "My parents owned a fine setter. They sent him to a farm forty miles away, to be trained. On taking him from the wagon when the farmer reached home, he got away and came home. He ran right up stairs into a room where my mother lay sick, putting his forefeet on her bed. . . . He was not to be driven from her bedside that night."

31. "A member of my family was a witness to the following incident: A farmer living near North Bend on the Ohio, transported his farm products on a flatboat down to Vicksburg. On one of these trips he took a highly prized dog. At the landing place at Vicksburg the dog disappeared. About a month after the owner had returned the dog came home poor and half-starved. He had travelled hundreds of miles, swam rivers, threaded forests, forded swamps and faced starvation to return to his home."

SHEEP. 32. "Flock of sheep in the spring have started about the usual time for the range where the older ones of the flock had pastured for two or three years. The pastures were on high hills, and the warmth and dampness of spring may have produced a degree of discomfort that reminded the sheep of the fresh pastures, breezes and hillside springs, where, shorn of their fleeces, they had enjoyed previous summers."

Cows. 33. "A man in our neighborhood has a cow that runs away from home. She will be gone for a day or more, and then will come back again."

34. "Our cow had spells of going away every month last summer."

35. "Mr. C. had a cow that would leave home every chance she could get, and would go into the country. Sometimes found ten miles away from home."

36. "A cow that will make her escape from pasture and return home, at a distance of several miles, at every opportunity."

37. "A herd of young cattle belonging to my grandfather escaped from a wild pasture about the last of September, and came home, a distance of twelve miles."

38. "Sold a cow to a man living about twenty-five miles away over rough hills and streams. She came back in a few days and stood by the gate until we let her in. She was again taken to her owner, but soon returned. It was very cold weather. We drove her away and made her stay outside of shelter, but without avail. Fearing she would die of hunger and cold we bought her back."

HORSES. 39. "Horses always come toward home faster. Have known very few to wander away from home."

40. "Horses become attached to home if it is one in which they are treated kindly. Know a horse raised and owned by one man until the horse was quite old. He was then sold to a person who kept

him, not far from his former home, but the horse was so homesick that he refused food and water, and would immediately start for home on being released. He was not allowed to return to his old home and consequently died of homesickness."

41. "Have known dogs, horses and cows, to suffer so intensely from evident homesickness, and so little food did they eat that great weakness and emaciation resulted. The diagnosis was confirmed by allowing such animals to be taken to their homes, when appetite and health promptly returned."

42. "Horses and cows will often wander in search of more or better food, but will soon return."

These cases indicate sufficiently the causal efficacy of food (case 42), temperature and seasons (32), in impelling domestic creatures to wander; and likewise emphasize strongly that the procreative processes ill-adjust periodically, the organism to its home, and further, that along with these physiological changes are co-operating the instinctive desires for pairing and seclusion during the periods of nest-building, laying (cases 4, 5 and 6, etc.), parturition. In some cases the whole periods of gestation is one of seclusion (case 17). Cats, dogs, cows, and even horses will often hide their young (case 19), especially if one fondles or pays them considerable attention in any way. The many advantages derived by seclusion from members of their own and those of other species during this whole period are self-evident. A hen will lay in the woods, and come home to roost and feed. A cat will keep her kittens in a basket at the next neighbor's barn, but brings them home three times a day for meals, a cow nurses and conceals her calf in a thick copse, but pastures in the open field. Thus domestic animals, like the birds, often make an effort to separate the reproductive from the vegetative areas even during and after the period of gestation.

The periods of heat in the cat, dog and cow, are coincident with their leaving home. Doubtless the horse would prove no exception if he were allowed equal freedom. It appears that the periodical physiological changes of the sexual organs completely overpower whatever adjustment the organism may have effected on a vegetative basis, and impels it to seek forces that will restore its equilibrium. Good food, comfortable quarters and kind treatment (case 27) are no longer attractive. The male of both the feline and canine races leave their comfortable vegetative quarters to become the paramour of a female of their respective species, and this too in the face of repeated bitter experiences, strength challenged on every hand, deadly combats waged with other male suitors, many a kick and cuff delivered by man, and of privations and hunger continually besetting them.

The appreciation and love for home in domestic animals is wide spread and oftentimes very intense and pathetically ex-

pressed. A new cot, a new kennel, a new manger of strange smells and sights, a new master with new and strange methods of treatment produce at times acute cases of nostalgia in dogs, cats and horses.

The observations of this section indicate that temperature is the chief cause in the majority of fish movements, likewise of lobster and a few mammals, as squirrels, monkeys and porcupines. In so far as it affects the food supply it may be regarded as an indirect cause among all species. Food and atmospheric pressure seem to be the dominant forces among many insects, *e. g.*, locusts, grasshoppers, etc. The procreative instinct is operative in all the species considered save the lobster, and probably the locust. With certain land crabs, butterflies, fish and eels, all birds, many rodents and the wandering of all domestic animals, the procreative instinct, I am persuaded, is paramount.

No one factor acting alone is responsible for the instinct. It is the product of a nexus of forces co-operating and supplementing each other. But when the relative *intensities* of the many factors are considered, together with the circumstances and the order in which they operate, it appears that the procreative instinct is the initiative, the primal factor, and that cosmic forces give precision, definiteness, and periodicity to its expression.

SECTION B.

Migrations of Primitive Man. The present section is concerned with the wanderings of primitive man, to the end of exposing in rough outline the customs, habits and characters of a migrating people. The conception of the migrating instinct thus seen in the race may improve our position for interpreting the instinct as expressed by the individual.

Ethnologists,¹ generally, subscribe to the assumption that man must have begun his career on some fertile island² or region in the tropics.³ While here his food consisted of the fruits and herbs of the forest. He was a frugiferous animal. Increase in his numbers soon forced him to migrate into regions less secure and blessed with a less genial climate. These forced movements compelled him to face a host of new conditions, *e. g.*, new climate, new food and a new array of enemies. As he migrated farther and farther away from the tropics the food supply came gradually to be seasonal instead of perennial. To secure food during the interim of the fruit bearing season he drew on the lakes and rivers for *fish*—his first artificial food.

¹ Morgan, Lewis H.: *Ancient Society*, p. 20.

² Lyell, Sir Charles: *Antiquity of Man*, p. 433.

³ Mason, O. T.: *Migration and the Food Quest*. The Amer. Anthropologist, Vol. II, No. 3, 1894.

They "were universal in distribution, unlimited in supply and the only kind of food at all times attainable.

It is quite probable, too, that after coming within range of seasonal changes his dependence upon stream and forest for food compelled him to migrate back and forth to some extent with the seasons."

¹Brinton says: "These periodical journeys extend hundreds of miles and embrace the whole tribe. This must also have been the case with primeval man when he occupied the world in paleolithic times. His home was along the shores of seas and the banks of streams. Up and down these natural high-ways he pursued his wanderings until he had extended his roamings over most of the habitable land." ²Such is the case among modern primitive peoples who control as yet but few of the forces of nature.³ While fish food rendered man to some extent independent of climate and locality he was forced to limit his excursions along sea shores and river courses until he had acquired sufficient skill with bow and arrow to kill his prey at a distance. Skill with these implements permitted distant excursions into the forest; fruit and fishing areas might now be deserted at a less risk of perishing from hunger. The chase became the highest of arts, the strongest incentive to wandering in all probability that man has ever received.

These three stages, the *frugivorous*, *fishing* and *hunting* furnished admirable conditions for the origin and growth of the *wanderlust* spirit. Their periods were *long* and the stimulus *intense*. There is much evidence from geology and paleontology showing that these periods may count their years by tens of thousands, that the transition from the frugivorous man to the nomad is many times longer than from the dawn of history to modern times. If psychic evolution has at all paralleled structural in point of time, there are strong reasons for believing that man was merely a fruit gatherer longer than a fisherman, a fisherman longer than a hunter, a hunter longer than a nomad and the latter longer than a farmer and home-maker in the modern sense.

¹ Brinton, G. D.: *loc. cit.*, p. 74.

² Mason sets forth the view that America was accidentally settled by some remote ancestors of the red man who left their home in the East Indies in quest of food and crept slowly but surely along the coasts of China, Japan and Aleutian shores until they reached the shores of Western North America. Likewise Otto Sittig (Smithsonian Report 1895, pp. 519-35) says that the islands of the Pacific were peopled by compulsory migrations. The frail crafts of the natives of the Malayan Archipelago while in search of fish and other food were accidentally caught by contrary wind and current and carried to more distant islands.

³ McGee, J. W.: The Amer. Anthro., Vol. VIII, No. 4. 1895.

Victor Hehn says: "We cannot sufficiently estimate the slowness and difficulty of the transition from a wandering hunter's life to the taming and tending of cattle, nor of that from nomadic freedom to a settled domicile. Necessity must have been very pressing before the shepherd could resolve to dig up his pasture land, to sow grain, to wait for its growing . . .

. . . and so tie himself down to one spot like a prisoner and a slave. . . . In the same way the hunter felt cattle breeding a kind of slavery. Armed with bow and arrow . . .

. . . he freely roamed the woods. . . . If he had the luck to kill a wild bull, he could feast for days." Hunting must have become unprofitable, indeed, before the less skillful, hampering and humdrum arrangements of cattle tending were resorted to as a means of support.

Among the many factors arguing that man has and is passing through these several stages are those represented (1) in the primitive ways of the Tasmanian, Bushmen, many Indian tribes, Gypsies, Bedouin, and nations of the Mongoloid type; (2) by a large class of individuals in civilized society that neglect home life and throw off responsibility at every angle to become a planomaniac, a globe trotter, a Thoreau, a Robinson Crusoe, or a Captain Kidd; (3) by the atavistic activities of childhood, *e. g.*, fondness for water,¹ tree climbing, hunting trading and bartering, etc.

To get a composite view of the planomaniacal² type I quote from one hundred and forty-four cases³ bearing on that sort of an individual.

1. F., 35. "Leaves home nearly every day immediately after breakfast to go visiting—is discontented and unhappy when compelled to stay at home."

2. F., 48. "On the go from morning till night—sometimes only running to see her nearest neighbor, sometimes going away on the cars—she keeps this up four or five months at a time, then suddenly stops and will not leave her yard for several weeks, nor does she care to receive company during her stay-at-home spells."

3. F. "Married, does not stay at home more than two hours during the day—spends her time in running about. She is young and does not have very much to do, perhaps she gets lonesome."

4. F. "Seems restless, is out calling every day—can't stay at home long at a time, although home and home-life is attractive and pleasant."

5. F., 50. "Married, educated, raised a family who are ignorant through neglect. Kind hearted, picks up and visits for a week, or will wait on the sick for weeks at the neglect of her home duties."

6. F., 30. "Good natured, smart, good cook and yet she allows her little girls to come home from school and prepare their own dinners. She leaves often after breakfast and does not return till bed time. She does not seem to do it to get rid of work, as often she will

¹Truancy, *Ped. Sem.*, Vol. V, No. 3, pp. 396-419.

²Rubric VIII of Syllabus.

³Ninety-five per cent. reported are females.

be helping some one to do just what she has left undone at home." (Many cases of this kind.)

7. F. "Married, quick and active, will take one child in her arms and have the others following after. Household duties do not worry her in the least. She says life is too short to waste it in the house."

8. F., 30. "Has a fixed day to visit each of her friends every week—can't be found at home more than two days in the week."

9. M., 52. "A comfortable home, good clothes and food, but will not stay at home. Always finds some news to carry from one place to another, and *is always ready to eat.*"

10. F. "Has a large family, always on the go in all sorts of weather, will keep her children out of school to stay with the little ones. Her calls are of a gossiping-seeking sort." (Five cases of this nature.)

11. F., 50. "Not interested in the duties of home, neglects them to go calling, cannot bear to be alone."

12. F. "So fond of calling that she will bring her cooking to our house. There is no special reason for her doing so."

13. F., 50. "Married, four children, always on the street, or shopping, will visit the same store several times a day."

14. F., 25. "Unmarried, never satisfied at home, has no taste for reading or domestic life. Loves to talk and carry news."

15. F. "Always making calls. I think it is to find out other people's business. Is the first to call on a new neighbor."

16. F., 40. "Always on the street, delights in gathering and redistributing news." (Cases like the last three are most numerous.)

17. M., 48. "Neglects his family and farm to talk with neighbors, is fond of trading horses, etc., visits all public gatherings."

18. M., 56. "Had a good farm and well stocked, suddenly abandoned it to his family, and went calling from neighbor to neighbor. Fond of children, well read, would work hard for a neighbor, but would never receive any pay—would only occasionally do a hard day's work at home."

19. F. "A member of every club and society in which she can gain a foothold, dips into everything, has done a little of everything, fond of doing committee work."

20. F., 30. "Neglects home to visit and be with other people. Good to sick and needy, will do menial work away from home that she will not do at home. Is fond of going to weddings, funerals, parties, etc."

21. F., 30. "Is noted for going to funerals and public gatherings of all sorts."

22. F., 40. "Always looking after the needy and sick, a great church goer, attended all week and Sunday meetings, and all funerals that she possibly could. Her friends once saw her going to the funeral of a noted pugilist, though they could not understand how she could possibly be interested in the deceased."

The funeral and club goers form somewhat a separate group, yet illustrate the lack of home interests and aversion to static conditions.

24. M., 22. "Married, seldom at home, fond of horse trading."

¹The impotency of the home spirit, the desire to lead a semi-roving life and the attendant psychoses of such a people are

¹Rubric VI of Syllabus. 217 cases reported, 23% of which were forced to move because of a failure to pay rent.

further illustrated by people who move frequently. The following are instances of families who move often for some other cause than failure to pay house rent.

25. "A lady and her daughter spend much of their time looking for a new boarding place. They are rich and hard to please."

26. "A farmer, lost a good farm by bad management, has tried several occupations, is discontented, moves every year to a new farm."

27. "M. moves about every two years, always to a different part of the same town. He is always changing his occupation."

28. "Husband indolent with little business ability, wife is ignorant and slovenly, move twice a year. It has come to be a habit."

29. "This family is never contented, think if they could be in some other place all would be well. Within four years they have moved seven or eight times."

30. "This family moves every spring and fall. The man has very poor calculation and generally thinks that if only he were *somewhere else* he might do great things."

31. "This family moves to avoid cleaning house. They endeavor to move into one already cleaned."

32. "This farmer has moved every year for 28 years, moved every spring thinking he would get a better farm."

34. "A lady has moved four times in five years,—although she owns several houses, she lives in a rented one. She is a very restless person."

35. "This family moving into a new place think it delightful and can't praise it enough. They soon grow dissatisfied and move again. They move back and forth from city to country. They are always in an unsettled frame of mind and think they can do better *somewhere else*."

36. "Each time this family moves, they think they are getting a better place. They move every two or three months. They have moved from a house and then back to it again in a few months."

37. "I know many families who move frequently. They always think the new tenement, which may be no better, has some advantage. They do not often get less rent, neither do they leave unpaid rent behind; sometimes they do not even change landlords, nor do they go beyond a radius of a mile for years."

38. "Have known this family for twenty years. They move on the average every six months. They have always lived in the same city, pay their rent—are respectable people. Each time they move they paint, varnish, and paper throughout, build new cupboards and begin cultivating grass and flowers, only to be left in a few months for another neighborhood."

39. "Family of four, all well educated, are continually moving about, from one part of the city to another; they will have a very nice home for about a year, then sell all their furniture and begin boarding. After a short time they become dissatisfied, buy new furniture and go to housekeeping again."

40. "This family is not content to remain long in any one place, grow tired of house and surroundings. They are nice people, much respected."

41. "This family moves about because they never like their neighbors. They usually move two or three times every year."

42. "I know a man with a family of nine, moves from two to five times a year. He is a horse jockey, works but little, loaf around the post office, stores and other places." (Eight cases of this character.)

43. "They move about every four months, are regarded as shift-

less, unstable in character, contented in one place as long as there is novelty, but soon become discontented and move." (This "shiftless" class forms 18 % of the number who pay their rent.)

44. "My grandfather would never stay in one house more than six months. He said he got tired of seeing the same things. They say he was just the same when a boy, was always changing his room and rearranging things. As a young man he was always changing his boarding place."

The planomaniac flees from domestic cares, has no interests for modern civilized ways, and will not fuse with them. He could not, if he would, for he belongs (using geological analogues) to a different and earlier formation. We should not wonder at his dread of solitude (cases 3, 4, 5, 11), at his being lonely in the midst of modern environment. To such his mind is vacant, hence his pursuit for diversion, and search for his *kind*. Zimmerman¹ says "Vacant souls are always burdensome to their possessor; and it is the weight of this burden that impels them incessantly in the pursuits of dissipation for relief." How primitive and semi-roving are these traits: "always ready² to eat" (case 9), desire to barter³ (cases 17, 24), working⁴ by fits and starts" (case 18), "shiftless" cases (cases 28, 42, 43), "slovenly⁵ and unkempt in person," indifferent to and with seeming inability to fight dirt.⁶

It appears, too, that the desire to rove is not abated with advancing age, not even with the increase of domestic and business cares. The cases cited indicate that there are persons in the midst of all degrees of intelligence and culture that minimize the value of a permanent home, that persist with seeming delight in a roving and nomadic life. Their lives are devoted in searching for the new, getting acquainted with the unfamiliar, gathering and distributing news, and dipping into new enterprises. They are possessed by a consuming curiosity, frequently of the idle sort.

The concomitancy of the roving and curiosity instincts in the same individual suggests a common origin, if not a causal relation. The conclusions⁷ of naturalists⁸ and genetic psychologists⁹ are to the effect that curiosity arose from the hunger and fear

¹ Zimmerman: Solitude, p. 12.

² "These Indians are disposed to gluttonize in idleness, when opportunity arises, when their power for consuming is no less striking than their power of abstaining. This characteristic of the tribe is possessed by other primitive peoples." W. J. McGee, Amer. Anthro. Vol. VIII, No. 4, 1895.

³ The Bedouins possessed this trait in a high degree. See Ency. Brit

⁴ Ellis Havelock: The Criminal, p. 101.

⁵ Lubbock, Sir John: Prehistoric Times, p. 432.

⁶ Bancroft, H. H.: Native Races.

⁷ Darwin: The Descent of Man, p. 71.

⁸ Romanes: Animal Intelligence, p. 279.

⁹ James: Psychology, Vol II, p. 429.

instincts. The motives for animals to investigate the unfamiliar, it would seem, are twofold, (1) to see whether or not the object in question is harmful, (2) to see whether or not it is palatable. Likewise the passions for excessive call making, gadding about, "the first to call on a new neighbor," continual shopping (but rarely purchasing), sampling and "sizing up" the material and mental furniture of a newcomer may have originated out of the necessity, common to all organisms, to know what is harmful and friendly, nourishing and distasteful in their *milieu*.

Interwoven with this curiosity plexus of motives, sometimes separated from them, is a longing for the unexpected, moving with the hope, Micawber-like, "That something may turn up," imagining that the other side of the road is always the better. They have an insatiable desire for conjuring with that unknown factor that lurks in the untried, to commit their fortunes to the play of the mysterious and unconscious forces of the universe which to so many lend an irresistible charm to a new game, new neighbors, a new house, a new farm, a new position, a new enterprise. In gambling it is the element of chance, in trading and barter it is termed luck. Hence it is that we find so many of these people doing a shiftless, bartering and gambling business where the conditions of chance and luck have their fullest swing. In all probability these conditions were at their best during the life of the primitive hunter and trapper. Here the degree of probability that labor will be proportionately rewarded is at a minimum. The ratio of reward to labor becomes so infinitely small that he comes to regard his rewards and successes due to chance rather than personal effort. One should not wonder, then, at barbarous and semi-civilized people persistently and continually creating conditions in which chance is at a maximum. Trapping, hunting and fishing are pursuits that reward more by chance than deliberate effort or certainty. Daily bread is the reward of *one lucky* arrow, spear, trap or net out of a hundred of such instruments and not by the sweat of the brow. The psychology of longing to be in some other place, for new conditions, for speculating, for gambling, is a reassertion of the old associations between chance and reward formed when the welfare of man was largely dependent on the mysterious forces of chance.¹

Probably the gypsy is the best type of a wandering people

¹The origin of many forms of gambling, and games of chance and lot as opposed to skill among the Chinese, Koreans, North American Indians and many other primitive tribes, lends considerable support to this theory, in that they all can be traced back to throwing the arrow, or tipped and feathered bamboo reeds as well as species of dice. . . . See Stewart Culin: Korean Games.

who have kept intact the customs and habits that once universally prevailed. The gypsy¹ that we know is quite different from those of other countries in their manner of getting a living. In Egypt they practice the art of serpent charming and conjuring; in France and Spain the girls sit as professional models; in England we meet Gypsy Methodist preachers, actors, quack doctors, chimney sweeps, carpenters, factory hands. In every land the men are workers in metals, musicians and horse-jockeys; are never scientists, barristers, or men of large affairs. In this country they travel about over the country in light-running canvass covered wagons, laden with their goods and chattels. They subsist by fortune-telling, horse-jockeying, tinkering, sometimes by selling small articles, trading, gambling, by theft and deception. They are dirty² both in person and cooking, lazy, fond of drinking and smoking. They are charmed by gaudy dress and jewelled ornaments. In no country have they ever been known to farm. A few own land in this country, but they seldom occupy it, preferring the wagon and highway instead. They keep both dogs and horses, being very fond of the latter. They have deep emotions, enjoy life, are highly imaginative, and extremely fond of music.

The gait of the gypsy is not jerky, angular, and individual, but rhythmical, racial, swaying from side to side, generating, roughly, from the hips up, sections of an inverted cone. The negro has a similar gait. This animal-like motion is due to the dominance of the fundamental muscles in walking as opposed to the finer, accessory muscles that stamp individuality upon the Caucasian gait. Prof. Shaler observes that the gypsy will not follow the sidewalk and brick pavements. They prefer the middle of the road.

The origin, together with the traits of a wandering people, have thus far been sought in the vegetative, the food getting side of man. There are impulses and irradiations from the reproductive functions whose significant bearing on the wandering instinct call for consideration.

The evidence furnished by Bancroft,³ Westermarck,⁴ School-

¹ For an extended account of the probable origin and customs of gypsies, see histories by C. C. Leland, or George Borrow.

² This is not universally true as the following will show, quoted from a competent observer: "This party of gypsies were scrupulously clean, had lots of silverware, dishes, etc., all of which were as clean as could be. The children, too, were cleanly and neatly dressed."

³ Bancroft: *Native Races*, Vol. I, p. 351.

⁴ Westermarck: *The History of Human Marriage*, p. 34.

craft,¹ Hill,² Ellis³ and others, indicate strongly that in one stage of human evolution an annual pairing season took place in the spring or early summer months. Westermarck, after an exhaustive research on this subject, says: "It is, therefore, a reasonable presumption that the increase of the sexual instinct at the end of spring or in the beginning of summer, is a survival of an ancient pairing season depending upon the same law that rules in the rest of the animal kingdom." The evidence of the preceding section shows that there is an intensity increase in the human sexual functions during the spring, not yet suppressed by law, religion and social customs. There is every reason to believe that pairing was decided by the "law of battle." This archaic habit is known in anthropological literature as *wife capture*. That this custom was once general, if not universal, is inferred from the symbols⁴ of capture⁵ that are so wide⁶ spread among all peoples⁷ at the present time. Several mythic legends, as Pluto and Proserpine, Boreas and Orithya, Theseus and Helen, the Romans and the Sabines have in all probability their foundation on the custom of systematic capture of wives among such ancient races.

The desire for, and methods of selecting a mate inaugurates practically the same activities as are displayed by lower creatures when accomplishing a similar purpose, viz., the "law of battle" and wandering. Olaus Magnus⁸ represents the tribes of northern Europe, as continually at war with one another, either on account of stolen women, or with the object of stealing women. In Australia the capture of wives is a signal for war, and as the tribes have little property, except their weapons and their women, the women are at once the cause of war and the spoils of victory. The same is essentially true of the Bonaks of California, the Tasmanians and Maorians. The coin-men of Patagonia make excursions every year at the time of "red leaf" from the mountains in the north to plunder Fuegians of their women, dogs and arms. McLennan thinks that the modern groomsmen or "best man" is the legitimate descendant from the early fighting and protecting protegee of the bridegroom.

War waged for any cause whatever, necessarily strengthens

¹ Schoolcraft: Archives of Aboriginal Knowledge, Vol. II, p. 224.

² Hill, A. S.: Nature, Vol. XXXVIII, p. 250.

³ Ellis, A. B.: Popular Science Monthly, Vol. XXXIX, No. 2, pp. 207-22.

⁴ Westermarck: *loc. cit.*, pp. 283-402.

⁵ Wood, Edward J.: Wedding Day in all Ages and Countries, 2 vols.

⁶ McLennan, J. F.: Studies in Ancient History, Chapters I, II, III, IV, V.

⁷ Ellis, A. B.: *loc. cit.*

⁸ Quoted from McLennan's Studies in Ancient History, p. 55.

the wandering instinct—the aggressor in pursuit of his prize, and the aggressed exchanging domestic duties for those of defense and regaining losses. Out of such conditions arose the themes of the greatest poems of antiquity, those of Homer and Virgil have made Ulysses and Æneas classic wanderers for all time. Peggotty wandering in search for Emily, Adam Bede's false betrothed tramping the highway in bitter shame and remorse, the untiring search of Evangeline for her lover over an entire primeval continent, St. Elmo's aimless wandering after killing his rival, are all mental creations that do no violence to human nature. Indeed tragedies and romances are most often the cradles of future wanderers.

The art of wife getting attained its most delicate and refined form in the 11th and 12th centuries, as set forth and practiced by the Troubadours and Courts of Love.

So charming and seductive were their lives and methods of wooing, that every nobleman of any merit, many princes of royal blood, and even four kings became ardent devotees. Love was their theme, their Alpha and Omega, music and wandering the methods of its exposition. They write: "It¹ is love that makes me sing." "For sweet love do I labor night and day in the improvement of my lays." "For love sing the birds, and for love sing I." Says Rowbotham: "The leading and characteristic feature in the life of every troubadour was, that he was expected 'to go through the world,' . . . 'to go from court to court.' At the *first breath of spring* (italics mine) the troubadour mounted on his steed . . . sallied out in quest of listeners, and prepared to indulge in what adventure might befall him on the way."

That the activities and attendant passions of (1) the annual pairing seasons, (2) of wife capture in its various forms and consequent wars, (3) of the various forms of symbolism of wife capture and (4) of the ever recurring romantic episodes among civilized peoples everywhere, have impressed the human soul, and have differentiated it in a special way is highly probable. The product of this differentiation is the instinct that impels man to desert home and vegetative stores and seek a world where the procreative functions and its higher irradiations may assert themselves. It would be absurd to interpret the precocious runaways of adolescence, the roving life of many individuals or the life of the vagrant as a direct expression of the procreative functions seeking conditions for satisfaction as witnessed in wild and domestic animals. Scott² has argued that these fundamental passions may be irradiated, long-circuited or trans-

¹ Rowbotham, J. Frederick: *The Troubadours and Courts of Love*, p. 226.

² Scott: *Sex and Art*, *Amer. Jour. of Psy.*, Vol. VII, pp. 153-226.

posed into a hierarchy of activities ranging all the way from the gross sensuous impulse of a marauder to the idealistic sentiments of youth that urges him to go forth espousing freedom's cause, waging war to reclaim a holy shrine, or to a missionary in any good work. Between these two extremes may be mentioned passions to start life, seeking wider liberties, for adventure, yearning for space, for solitude and the like.

The impulse to go off at the approach of the menstrual¹ period, the desire for seclusion during parturition,² and the passion for a wedding tour can only be mentioned here as subjects for investigation. No adequate data exists on this phase of the subject.

Historical Migrations. This subject presents three items of interest, (1) the degree of civilization of a migrating nation en masse, (2) the direction of the route, (3) the climatic conditions of the country from which the nations move, and of that to which they go. The organization of a migrating people has usually been of a comparatively high³ state. They have been skilled in the several arts of war, in making and using weapons, and in handling great bodies of men. According to Von Hellwald⁴ the direction of the migratory streams will be found always to lie in the axis of the greatest longitudinal extension of the continent. The historical migrations⁵ in the old world have been from the high plateaus of Eurasia in the east to the narrow land areas in the west. In America they have proceeded from the broad land areas of the north to the mild tapering peninsula of the south. Doubtless the mountain ranges that lie in the long axes of continents determine to some extent the direction. Both the temperature and wind of large water areas are more uniform than that of great land areas. Countries, therefore, wholly or partially surrounded by water areas, or that are so situated as to have their shores bathed by strong sea currents, and their surfaces blown over by winds coming from large sea areas, enjoy the most delightful climates in the world.⁶ The countries along the shores of the Mediterranean Sea, south-

¹ The writer is informed by a student of psychology that his wife when a girl in her teens at home and at college experienced a vague impulse "to go off," not to hide specially, but to be alone, a few days before each monthly flow. Several girls of her intimate acquaintance professed to her a like experience.

² When the time of a Schoshone woman's confinement draws near, she retires to some secluded place, brings forth unassisted, and remains there *alone* for about a month. Bancroft: *Native Races*, Vol. I, p. 437.

³ Lubbock, Sir John: *loc. cit.*, p. 586.

⁴ Von Hellwald, Frederick: *The American Migrations*, Smithsonian Report, 1866, pp. 328-45.

⁵ Cram's *Universal Atlas*, p. 269, 1893.

⁶ Davis, W. M.: *Elementary Meteorology*, p. 338, 1894.

ern California, portions of Chili, etc., are freed from extremes of temperature, winds, and floods and frequent undulations of atmospheric pressures. England, East China and Japan are lands whose climates, though in the great land areas or just adjacent to them, are tempered and uniformed by sea winds and currents. In such countries, *e. g.*, Egypt, Japan, East China, Greece and Rome, are found the oldest and most permanent institutions of man. In them civilization was cradled and wrought out the deeds that form the bulk of history.

On the other hand the great land areas of the N. temperate zones are characterized by wide annual ranges of temperature, in some regions long drouths followed by short but heavy rainfall, and by a wide spread and frequent undulations in atmospheric pressure.¹ Such climates are found on the eastern and southern shores of the Baltic, the northern lands of Russia, northern and central Asia, and the large interior of North America stretching north of the Missouri and northwest of the Great Lakes. The Steppes of Turkestan, the great desert of Gobi and Takla-Makin² with moving dunes of sand, portions of Arabia and Persia are all dry lands with a relative large range of temperature.

The uncertain changeable geographico-climatic conditions of these land areas, it seems, would foster and emphasize the several migrating traits already surveyed, would furnish just the right stimuli to set agoing from time to time the old migrating instinct implanted in the race in prehistoric times. Such lands cradled the Tartar, the Hun, Visigoth, Vandals, the Bedouin—the children of want and hard circumstances, the hardy, brawny, restless races, in whose blood there is a good mixture of iron, and which have come forth *periodically* to destroy the luxurious and the wealthy,³ to lay in ashes the arts and culture that flourish where the forces of nature are more uniform and less rigorous. At the present time, according to Tarde⁴ and Below, the life of the pastoral people in the Sahara, as on the plateau of central Asia, is passed in circular migrations, returning to their points of departure. He thinks that caravan life, like sea life, has incited others to a roving life through *imitation*. Commerce conducted in any form whatever, as caravans, railways or ships, is a powerful stimulus to wander-

¹ For physiological effects of elevated climates, frequent undulations in atmospheric pressure, etc., see Hand-book of Medical Climatology, p. 61, by Dr. S. Edwin Sully, also Warren P. Lombard in *Amer. Jour. Psy.*, Vol. I, pp. 5-71.

² Heden, Dr. Sven: McClure's Magazine, Dec., '97. "It was all sand-moving dunes of sand. The days were very hot, the nights were bitterly cold. The air was full of dust."

³ Holworth, Sir H. H.: History of Monguls, Chap's II and III, Part I.

⁴ Tarde, M. G.: Revue Scientifique, Vol. XLV, p. 747, 1890.

ing. The tenacity with which trainmen cling to the railroad, the stolid backwardness shown by the Mississippi River steamboat employees to quit boat life and enter other pursuits, are instances justifying Tarde's conclusions. A commercial people are cosmopolitan—rarely if ever homesick. It would seem that certain occupation predispose to restlessness and roving.

TABLE III.
Showing the relation between the age and the manner and causes for leaving home.

Age.	Male.	Female.	No. totals.	Injured feelings.		Love of adventure.		Love of nature.		To start life.		Impulsive.		Planned.		Loneliness.		To see opposite sex.	
				No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1	2	3	5									5	100						
2	6	5	11									11	100						
3	17	5	26									20	77						
4	15	8	23	3	13			3	11			19	82	4	15	12	46		
5	19	15	34	4	11			3	13			27	79	7	17	10	43		
6	13	11	24	4	16			4	11			14	58	8	20	12	35		
7	18	7	25	3	12			6	33			12	48	9	33	6	25		
8	26	5	31	4	13	4	16	6	24	1	4	12	38	11	36	4	16		
9	18	8	26	5	19	7	27	7	26	3	3	12	38	11	35	5	16		
10	32	6	38	10	21	17	44	12	31	3	11	11	42	14	54	4	15		
11	11	3	14	4	28	6	42	4	27	1	7	11	78	3	21	0	0		
12	28	8	34	11	32	14	41	4	12	4	10	16	47	15	44	2	5		
13	33	8	41	9	21	20	48	5	12	9	21	15	36	22	53	3	7		
14	38	5	43	12	28	20	46	4	9	8	18	16	37	25	58	2	5	2	4
15	44	8	52	19	36	22	42	4	7	10	19	18	36	29	58	4	7	4	7
16	26	4	30	8	26	16	53	2	6	9	30	8	26	20	66	4	13	4	13
17	12	2	18	4	22	9	50	2	11	4	22	5	27	11	61	3	16	3	16
18	15	1	17	3	17	8	47			5	29	3	17	12	70	4	23	2	23
19	7	1	8	1	12	5	62					2	25	6	75		25		
Total,	380	121	501	104	27	154	30	80	13	61	12	253	50	214	42	60	12	20	4

The Instinct in the Individual. The migratory instinct, together with the concomitant traits, so far as they can be

made out in childhood and early youth, were treated at some length in my paper on 'Truancy'.¹ It remains to note briefly in the light of all that has preceded the role played by the instinct in maturer² life. Our study thus far suggests that its germs are perhaps in every one—at least such is the view here adopted. The instinct is not an anomalous thing. It had a legitimate birth, and is an essential function of the soul. At what age or ages, under what conditions it will most probably control one's activities, and what will be its form of expression, *i. e.*, whether seeking a fortune, love of adventure, or fleeing from restraint, or what not, are suggested from the returns of the questionnaire,—Rubrics I and II.

For total number of cases of runaways, number of each sex, distribution according to age, and the relation between ages and the different causes for running away, see Table III and Chart IV. The manner of running off is partly a function of age (Chart III). All children that run off from one to three do so impulsively.³ Three to eight years shows a gradual falling in the impulse curve with a rise in the planning curve (Chart III). The child's growing interests and respect for home and parents' and the consequent desire to conceal his misdemeanors are probably factors at work here. From eight to twelve the curves are reversed. This corresponds roughly to the period of slow growth of brain, body, weight and height. It is a time, too, when the child partially slides out from under the sole care and companionship of parents, and sets up a social circle of his own. He is less sensitive and considerate to his parents' reproofs and wishes. Respect weakens, he waxes bold, questions authority. This dare-devil spirit may account for the child doing things impulsively, openly and above board. The ways and manner of leaving home, however, multiply with age. The curves (Charts III and IV) showing the relation between ages and different causes for leaving, are based on too small a number to merit a detailed description; they do, however, emphasize this fact, that childhood and youth are affected differently by the same causes, and further that the causes in-

¹Truancy as Related to the Migratory Instinct: *Ped. Sem.*, Vol. V, No. 3, 1898.

²It is needless to say that the data for a thorough study is yet to be collected. There is much literature of an idealized sort, descriptive of the professional tramp. But the tramp by no means expresses all of the roving instinct—not all wanderers are tramps. Indeed, if adhering to fixed habits, customs and conditions excludes the roving instinct, then the tramp is not dominated by the migratory impulse, for he is exceedingly staid in all his ways. A study of tramps and vagrants, then, will not suffice our present purpose.

³See cases and comment: *Ped. Sem.*, Vol. V, No. 3, pp. 387-90.

crease as the individual comes to sustain wider and wider relations with society. For example, injured feelings in childhood may arise through an unfavorable comparison of their lot with that of their playmates, and from real bodily wrongs, or from objective conditions and processes while the feelings of adolescence are generally disturbed by subjective and imaginative conditions. His moulting ego is excessively sensitive to personal rights and honor, his good intentions are misinterpreted. The injured feeling curve attains its maximum in the fifteenth year. Again, childhood and adolescence are affected diametrically opposite by solitude. The former flees from loneliness, the latter often seeks it. Childhood goes to nature (Chart IV) for companionship, adolescence for solitude.

Probably one of the most faithful sources of wandering in adolescence is restricted liberty, or impatience under restraint. The following are two cases from more than a hundred bearing on this point.

1. F., 34. "Until I was twelve, I cannot recall having ever gone from home with pleasure, but during my early teens I began to feel a sense of oppression from remaining at home which became highly accentuated by the age of fifteen. I was then allowed to leave home to teach a little rural school. The sense of freedom I experienced was intoxicating (and not mildly). Yet I was under no real restraint at home. I simply felt restrained there. I think I had an irritating desire to find how I *alone* stood with the world, to feel myself detached from all that bound me. During this time I thought much of 'independence,' delighted in long lonely walks—often pictured to myself the freedom of the gypsy and delighted greatly in all tales and poems idealizing the gypsy girl."

2. F. "The noise of a city and the crowds of people always make me impatient to get away. I don't like even a day with houses in front of me—even brown stone, vine wreathed, is a burden to my spirit. I can get along in a very small room for myself and my belongings but I *must* have some space outside my window. When I had to live in the city I had such longings to escape that I would take a car in dead of winter and go to the end of the route and then walk until there was not a house or a person in sight and so get my equilibrium."

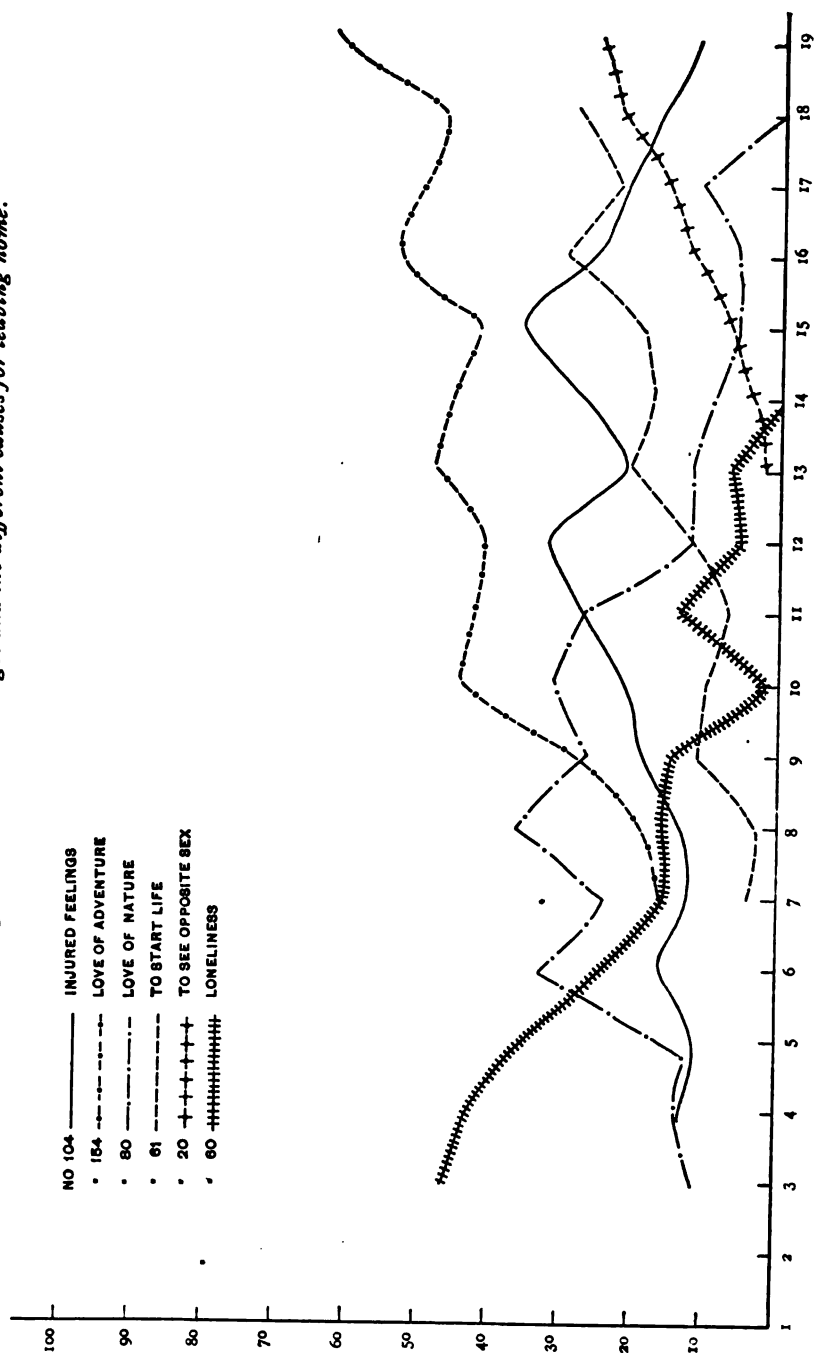
A student of tramps and vagrants writes me :

"It is my impression that the narrow, cramped conditions under which boys often live, without sufficient variety and wholesome interests in their lives, is responsible for much of the constant recruiting in the ranks of the tramp army. It is unnatural for young people to live a life of dead monotony, and the boy who breaks away in sheer desperation, without an education to equip him for any better life, soon drifts to trampdom and becomes irreclaimable to serious life."

While the charms of travel woo many to a roving life, travelling, especially on water, cures many of a roving passion. The following are from 280 cases of Rubric IV on the charms of travel :

CHARMS OF TRAVEL. 3. M., 26. "I enjoy a walk into far away country places for the sake of the sensation of delicious freedom, of

CHART IV. *Showing the relation between ages and the different causes for leaving home.*



the perfect mental abandonment. One feels as if he had shaken off the dead weight of mental contact, and the far off stretches of country promise more of the same kind of liberty."

4. M., 24. "I like being aboard a ship for the feeling of endless space and a sort of liberation from conventions that it brings. A long walk into a new part of the country has a charm for me. And I have enjoyed herding cattle on the prairie because it set me free from self-consciousness."

5. F., 33. "Have often felt as though the house, although comfortable and handsome, was choking me, and the moment I got my foot on the doorstep for a walk, even though a deep snow prevailed, I felt better. I feel intense pleasure when walking in the twilight—alone, have an elasticity of step and elation which makes me wish twilight would last for hours so that I could walk miles. Am in no sense a gad-about, and I hate call-making, but cannot hear the whistle of a locomotive without a tingling of the blood and a longing to be off—indeinitely, anywhere. Have led a sedentary life."

6. F., 21. "Either a trip on the ocean or a long ride on the train has great interests for me. The former soothes, puts me at peace with the whole world; the latter excites me, I feel boisterous, can hardly keep still, no matter how peaceful the scenery, it seemed that I could always see something wild about it, something that answered to my feelings."

7. M., 26. "The chief interest of travel to me is the seeing of new things. My hobby in the way of change is to get out into the country for about two days at a time, drop everything, cut loose from every thought that binds me to my work and walk in the woods. With me there is a peculiar emotional tone that goes with thoughts of travel."

8. M., 30. "The novelty of seeing new things and having new experiences are the attractions of travel. I sometimes get tired of habitual surroundings—I think from the monotony and sameness of repeated experiences."

9. F., 16. "A day's walk through the woods has the greatest charm for me. The freedom, the wildness, the quietness, the birds, flowers, all answering to an inner feeling of joyousness; a feeling of being *at home* with nature."

10. F., 20. "The new sights. I like, too, the onward motion, the feeling that I am going."

11. F., 19. "I think I never had a desire to run away, but sometimes in spring I have had desire to go for a walk by myself; I have gone to walk through the fields and woods. It seems as though I wished to enjoy it alone and not speak to any one."

12. M., 20. "In my experience the bicycle has held the most interest in the charms of travel. It is akin to flying, the swift motion and delightful breezes fanning your head are pleasant sensations."

The thirst for travel is a product of a nexus of factors. In our 280 returns, however, two groups of motives have dominated. First they show that travelling is a favorite means to destroy monotony, it breaks up the tedium of the hour; it shelves old experiences and sensations, that have induced a sort of mental cramp or fatigue. Travelling relieves this cramp by furnishing a superior sort of new psychical and bodily activities; second, they indicate strongly that the desire to experience sensations of motion is unique among human passions. Josiah Flynt says: "The possibility of

riding everywhere afforded by our net work of railways is alluring to the boy and often wins many to trampdom." Shaler thinks the love of adventure (chart IV) can best be satisfied by going to sea.

The sensation of motion, as yet but little studied from a pleasure-pain standpoint, is undoubtedly a pleasure giving sensation. For Aristippus the end of life is pleasure which he defines as gentle motion. Motherhood long ago discovered its virtue as furnished by the cradle. Galloping to town on the parental knee is a pleasing pastime in every nursery. The several varieties of swings, the hammock, see-saw, flying-jenny, merry-go-round, shooting-the-chute, sailing, coasting, rowing and skating, together with the fondness¹ of children for rotating rapidly in one spot until dizzy, and for jumping from high places, are all devices and sports to stimulate the sense of motion. In most of these modes of motion the body is passive or semi-passive, save in such motions as skating and rotating on the feet. The passiveness of the body precludes any important contribution of stimuli from kinaesthetic sources. The stimuli are probably furnished, as Dr. Hall and others have suggested, by a redistribution of fluid-pressures (due to the unusual motions and positions of the body) to the inner walls of the several vascular systems of the body.

Love of adventure (see table III chart IV) is apparently prompted by a variety of motives, *e. g.*, by rebellion against restraint, love of freedom, of travel, thirst for knowledge, chivalry; and also by the dare-devil, iconoclastic spirit that revels in the unexpected and courts fortune through the factors of lottery and chance.

Rubrics I, II, concerning runaways, and IX and XI, pertaining to homesickness, etc., are treated in a comparative way (table IV) as interesting from a sociological standpoint and as a further introduction to the material of section C.

Probably the most general and fundamental group of facts are those pertaining to the home and parents. The percentage of orphans in both lovers of home and runaways are comparatively small.

Tenantry is much more common among parents of runaways—35% as against 18% for lovers of home. The conditions of the home are classified into poor, moderate, comfortable and bountiful. The largest number of homes in both groups belong to the comfortable class. An examination of all the classes shows that the runaways bear by far the greatest number of inferior homes in an economic sense.

¹ Hall, G. Stanley: Study of Fears: *Am. Jour. Psy.*, Vol. VIII, No. 2, p. 157.

Nineteen per cent. of the runaways come from poor homes as opposed to no per cent. of home lovers. It is unnecessary to comment on the rest of the items compared—the table is self-explanatory.

TABLE IV.

Showing the comparative sociological conditions, traits, etc., of five hundred (500) runaways and two hundred and twenty-five (225) lovers of home (ages 1-20 years).

RUNAWAYS.		Per cent.	LOVERS OF HOME.		Per cent.
Parents.	Both living	86	.	.	80
	Partially orphans	11	.	.	16
	Wholly orphans	3	.	.	3
Do not own their homes		35	.	.	18
Conditions of home.	Poor	19	.	.	0
	Moderate	30	.	.	6
	Comfortable	40	.	.	58
	Bountiful	11	.	.	23
Not affectionate		45	.	.	9
Physically defective		12	.	.	0
Numerical relation in the family.	Oldest	23	.	.	20
	Youngest	25	.	.	32
	Only	23	.	.	2
	Neither	28	.	.	45
Sensitive		62	.	.	90
Demonstrative		60	.	.	32
Laugh easily		70	.	.	79
Cry easily		62	.	.	73
Generous		74	.	.	87
Careless in dress		52	.	.	10
Like crowds		79	.	.	36
Shun crowds		21	.	.	64
Careful of property		61	.	.	90
Regards others rights		64	.	.	93
Made no collection		45	.	.	12
Persistent in tasks		74	.	.	85

SUMMARY.

The discussion of migration of animals indicates that the most general initiative factor that disturbs the psycho-physiological adjustments is the procreative function, but that the mode and time of its operation is greatly modified by cosmic forces.

We do not trace with equal certainty the operation of the same factors in the same order and effectiveness in originating and controlling the instinct in man for the obvious reasons that he has freed himself to a great extent from these archaic forces and in a measure controls them; besides he has set up a *social cosmos*, as it were, of his own that must be obeyed. Despite these hindrances, however, we do get traces here and there of the persistency and effectiveness of *the inner, the cosmic* and the *social* forces involved in the differentiation

of the instinct. The movements of primitive man were controlled, in all probability, by the distribution of certain foods, by the physical geography of the country, and by the change of seasons. The factors of climatology together with the topography of the country have greatly controlled, if not actually touched off, the instinct as seen in historic migrations.

The passions for local roving, "gadding about," frequent moving and gypsying is a reassertion of the old psychoses that was formed when to know friend and foe were essential to self-preservation, and when the highest conditions of lot and chance were assiduously courted. Spring fever, ennui, psycho-physiological disturbances of spring, and of the lunar as well as certain solar periods, then, too, the vernal increase in the number of marriages and in the number of illegitimate births; the strengthening of the love of adventure, for independence and freedom at the onset of puberty; the greatest number of run-away adolescents occurring in the spring—all alike point to the general conclusion that the procreative functions and their irradiations and cosmic periodicities are joint factors in the differentiation of the migratory instinct. They are the factors that have ever periodically disturbed whatever adjustment that man may have effected with his environment on a vegetative basis.

Finally, the migratory instinct is general, if not universal. It is merely a matter of degree—sometimes very slight, too—from the mental throes, perturbations and secret threats of leaving home by the adolescent to their actual occurrence. The gradual passage from the adolescent who fights and smothers these several subjective upheavals and remains at home, or from the one who subdues the desire for change and continually adjusts himself to present tasks to the one who is overcome and breaks away is paralleled by the fine shades from sanity to insanity, or from the feint inner thoughts of to the actual committing of crime.¹

We are not then dealing with anomalous elements and characters. The germs and even at times the full fruition are in us all, partly as a heritage and partly acquired. (See cases 1 and 2.)

¹ Ferri, E.: *Criminal Sociology*, p. 43—"Every man, however pure and honest he may be, is conscious now and then of a transitory notion of some dishonest or criminal action. But with the honest man, exactly because he is physically and morally normal, this notion of crime which simultaneously summons up the idea of its grievous consequences, glances off the surface of the moral conscience . . . with the man who is less normal and has less forethought, the notion dwells and finally prevails."

SECTION C.

LOVE OF HOME.

The love of home is indeed an archaic theme in literature. An activity of the soul that arose very probably soon after the sex broad-ax dichotomized organic life. To build a home, furnish and protect it absorb the quintessence of the energies of the greater part of living species¹. The instinct is expressed oftentimes in an unmistakable manner by the unnatural and waning activities of wild animals in captivity longing to return to their familiar haunts.

Werworn² found that many lowly forms of pelagic life, although under the very best conditions, decrease considerably in volume in a few days, many die within less than a week. He kept beroës alive three weeks. One beroë that measured 2 cm. long, after 14 days captivity was only 6 mm. long.

Young shows that in vessels of the same shape the larger the area of the vessels, the greater the growth of tadpoles confined therein. 'De Varigny has found the same to be true of the pond snail. He interprets this dwarfing as a physiological or mechanical *impedimenta* to movements, *i. e.*, he would make free exercise one of the functions of growth. Darwin observes that insular animals are smaller than their continental congeners. For instance, in the Canary Islands the oxen of one of the smallest islands are much smaller than those of the others, although all belong to the same breed; the same is true of their horses. Spencer says "It is well known by all anglers that trout and other fishes are small in small streams and large in larger rivers."

According to Bates, only one of the largest species of the South American turtles will live long in captivity, the smaller ones die in a few days. Snapping turtles generally refuse food and remain shy and fierce, but taken young can be brought to feed. Sea snakes cannot be kept alive many days even in salt water. The vipers all vomit their food after being taken captives and will seldom take any further nourishment except water. 'Jordan found that female newts kept in confinement all winter were not so apt to lay eggs in the spring as those freshly captured. The

¹ The agricultural achievements of the ant common in several lands, the variety of architectural designs for the home and the certainty and cleverness of their execution as seen in the life history of ants, bees, fish, birds and both lower and higher mammals, furnish abundant examples of the large bulk of animal activities exerted for the realization of a and its belongings.

² Werworn: Pflüg. Archiv., Vol. L, 1891, pp. 439-440.

³ Young: Arch. des Sci. Phys. et Nat., Vol. XIV, 1885.

⁴ De Varigny: Experimental Evolution.

⁵ Jordan: Habits and Developments of Newts, Jour. Morphology, Vol. VIII, pp. 269-366.

duckbill¹ and pouched mole in spite of all care and attention live but a very short time in captivity. Hartmann, Chaillou and others give several instances of young monkeys dying soon after capture. Captured adult pumas² invariably pine away and die. Delboeuf³ allowed two different species of lizards to run together in his laboratory for over two years. One disappeared suddenly for three weeks, during which time the second one refused all food, and had no relish for insects and earthworms until the absent one returned. A species of snake (*pelias berus*) usually refuses all food; but if the floor of its cage is made to look like its native moor it will sometimes feed voluntarily. Cornish⁴ says nearly all animals dislike solitude and confinement. Tame hawks and falcons, if kept alone in a room mope and lose condition, and in some species a suicidal instinct is developed. Merlins kept in solitary confinement destroy their claws and toes.

These citations, though by no means exhaustive, illustrate that not only forcible curtailing or limiting conditions for exercise, but a sudden change of environment, feeding grounds or even loss of companionship will cause dwarfing, sickness and even death to wild animals.

Instances⁵ of the love for home among domestic animals and their intense mental sufferings when away per force were given in Section A.

Some of the factors making for the *love of home* in man are set forth in the cases below.⁶

1. F., 19. "I think that the order is mother first, father and brother equally. I like to think of my surroundings, at home in this order, the sitting-room, the two maples in the yard, the brook and the surrounding hills."

2. F., 20. "The elements in my own love of home are first my father, then sister, brothers, the house, and familiar spots on the farm."

3. F., 17. "... Father and mother and next my sister and brother—the home feeling which I have but which I cannot possibly explain."

The family as a whole or the member in the manner given in these three cases, of course, take precedence over all other elements in all the returns, therefore, they are omitted in the rest of the cases.

4. F., 25. Scenery and past association.

5. F., 20. House, water, hills, trees, familiar ways of life.

6. F., —. House, natural scenery, familiar ways of life.

¹ Bennett, G.: *Gatherings of a Naturalist in Australasia*, 1860.

² Hudson: *The Naturalist in La Plata*, p. 44.

³ Delboeuf, J.: *Pop. Sci. Month.*, Vol. L, pp. 395-99, 1897.

⁴ Cornish, C. J.: *Animals at Work and Play*, '96, pp. 31-38.

⁵ Selected at random from 200 answers to Rubric XIII of Syllabus.

⁶ Selected at random from 160 answers to Rubric X of Syllabus.

7. F., —. Friends, location and familiar scenes.
8. F., 18. House, hills, and mode of living.
9. F., 25. Natural scenery and associations connected with it.
10. M., 19. Of my father, mother, brother, it would be hard to tell which I love most. They are all a part in my life. But of the house and surroundings, hills and valleys, there is that lasting feeling which ties me to it.
11. F., 21. Hill, trees, and natural scenery around my own home seem dearer to me than those of any other place.
12. M., 25. Familiar ways of life, all the familiar parts of the house; its nooks and crannies, where old associations and memories cluster thick as swarming bees; the plot of ground about the house, and lastly the outlook from its doors and windows, such as hills, trees, lawns, etc.
13. F., 22. The room where we sit together evenings, my own room, my bird and other household pets, the scenery, especially the mountains.
14. M., 22. House itself, trees that stand before it, a hill back of it.
15. F., 26. Familiar books and furniture, and the sincerity and naturalness of home relations.
16. M., 27. Habit I think enters strongly into my love of home—accustomed faces, furniture, surroundings, etc.
17. M., 30. Familiar haunts, chance to relax and feel easy.
18. F., 21. Distant hills, domestic animals and pets, home habits and family ways.
19. F., 22. The house itself because I was born there—then the woods and fields, which abound in nooks so pleasant to me, familiar ways of the people about the town.
20. F., 18. Naturalness of home life, the cozy surroundings, trees, flowers, the peaceful river and sceneries, the sociability of friends.
21. F., 18. Ways of the home, everything seems familiar, the good times we all have together, freedom of the home, always open to my friends and all friends of the family.

Ninety per cent. of the cases are females. By far the great majority (62%) rank mother first, father second (30%). Some (3.7%) say that the members of the family do not separate out into individual preferences. They regard the family, as a whole, the strongest factor. Two per cent. rank parents first, followed by other members of the family. A very few (1%) think a brother or sister is first choice. Females have more preferences among members of the household, or, at least, hesitate less to undertake an analysis.

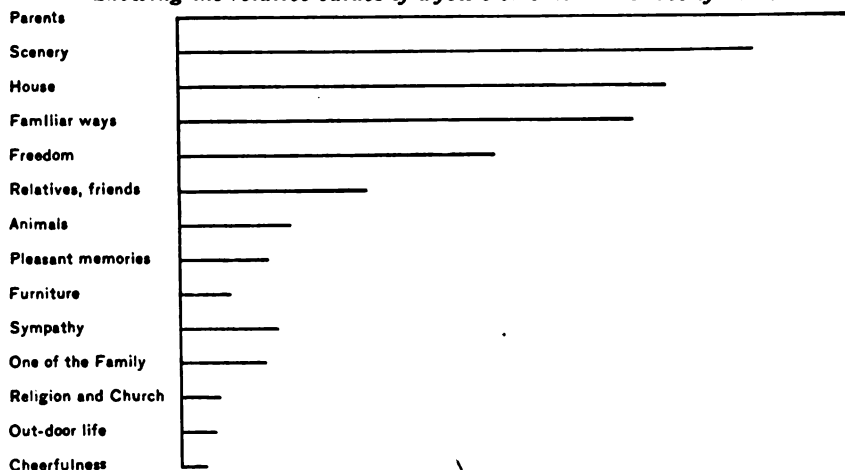
After members of the family the most common element is the *natural scenery* about the home (85%). This¹ consists of garden, lawn, familiar spots on the farm, trees, grove, river, brook, lakes, water falls, hills, distant mountains. Then, too, sunrise and sunset—on the prairie, or on the mountain, or from my window. The *house itself* (70%). Because I was born there—always been my home, its cozy rooms, especially my room, all my things are there. *Familiar ways* (65%),

¹ Per cents are estimated on the number of times the factors are mentioned.

the sincerity and naturalness of home life, the home "feeling," quiet way and way we do it, time for meals, table manners, evening chats. *Freedom of the home* (43%), place to relax and feel easy, absence of restraint by strangers, freedom to talk without fear of offending, to go where and when I please, free use of all the house. *Relatives and friends* (25%), genial ways, interested in me, good times together. The relative strength of these several elements is illustrated diagrammatically in Diagram II. One is surprised at finding sympathy so low among the elements enumerated. Phrases like the following occur: Sympathy for my work; for my troubles; for my inclination; for my plans.

DIAGRAM II.

Showing the relative values of a few elements in the love of home.



The love of home, it appears, is a complex of at least three general groups of factors: first, the personnel of the family; second, the variety of home life, both as to activities and material objects, especially objects in nature; third, the relation of the first two groups to self. If this relation is one in which the self-regarding interests have been administered to, the intensity of home love is usually a strong one.

It is noteworthy that those whose home affections are exclusively for members of the family, were the children of parents that moved frequently, or lived in tenement flats, and thus were robbed of the associations of trees, hills, mountains, lakes, and so on. The following cases are typical:

22. F., 25. "My love of home is almost entirely personal, as we live in New York city flats."

23. F., 21. "I love my home because it is the place where my

mother and father live. The hills do not especially strike my sense of the beautiful or the picturesque, as they only vary from about four inches to one foot in height. We have one tree in our yard, and it would not take very long to count the leaves on it. The natural scenery consists of rows of brick houses."

24. F., —. "My love of home is very strong, but I don't know that I can specify the elements in it. I think it cannot be the house or natural scenery, for until I was about grown I had never lived more than a year or two at the same place (being an itinerant preacher's daughter). I grew up with the feeling that wherever papa and mamma were was home."

25. F., 33. "I have known three homes. All handsome. In two of them my position was that of sister, in the third, wife. I find that the sense of home exists only with the sense of *personal possession and responsibility, and congenial ways of life.*"

Some factors lying apparently at the basis of the affections for home are emphasized by answers to Rubric IX. Eighty per cent. of the cases (104) are females.

26. F., 20. "Always hated to stay away from home, feeling that something might happen to my people, or that my mother might die before my return."

27. F., 18. Until within a few years past never objected to be away from home. Lost her father at 12, and since then will only very reluctantly leave her mother over night.

28. F., 15. Would never go out to parties or out with other girls. At her mother's wish she packed her trunk and made ready to spend a summer vacation in the country. She started several times, broke out crying each time, and finally gave it up.

29. F., 22. Gets homesick away over night even with her sister.

30. M., 38. Very systematic in habits, does everything by clock-work. Sociable and full of fun, but never goes away from home even for a night. Has been in the same office for 20 years. As a boy did not care to gad about the streets.

31. "Common thing for people of middle life to say it is an effort for them to get away from home, and that they can sleep better in their own beds. Know a lady of 25 who never likes to go on a vacation. A week away seems very long, . . . is not happy or at ease until in her home again."

32. M., 30. Very conscientious, an indefatigable worker, could never rest away from home *unless* his family were with him. Wants but a few friends.

33. M., 64. Does not like to be with crowds, never stayed away from home many nights in his life, dislikes to get out sight of the house.

34. F., 17. A regular home girl, good housekeeper and manager. Dislikes to meet strangers. When 12 or 13 would go occasionally to spend the night with a cousin, but scarcely found sleep. She seemed to be attacked with all the horrors of homesickness, would cry nearly all night. Afraid that mother might die that night.

35. F., 55. Married and lived on a farm, no family. She and her husband very often do not speak for weeks. She is fond of company, but never leaves home except to go to the market. She is very ambitious to make money. I think that is why she stays at home so closely. She is afraid to leave home lest something might go to ruin.

36. F., 88. Has, and always has had the intensest love for her little wee shabby home. She cannot bear to be away from it a moment just for sheer love of it. Just as a loving mother cannot bear to leave her

little baby. She cares for it in a way that is almost caressing in its fondness and prettiness. She permits no one to do a thing for her. She cleans it, scrubs it, and keeps it dainty with the utmost joy. I know from things she has said to me that it would pain her to have any of her dearly beloved house utensils carelessly used or handled. She once gave me a pretty piece of old-fashioned ware because she said that her grandchildren would be likely to break it if it was left to them, and she did not like to think of it ever being broken.

Last summer (her 88th year) she made her own garden, planted and hoed it. She had it plowed, but that was all. She could not bear to have any one touch it but herself. Her two sons, who live near by, would gladly do everything for her. Whenever I go there she takes me all over the little baby house, down cellar, into the woodshed, the pantry, shows me her cistern, her dishes and everything, just as we used to show off our playhouses when children. She is a woman of exquisite, native refinement; her thoughts are all very poetic and lovely thoughts.

Section B (Table IV) calls attention to the home life of home lovers as usually congenial and quite comfortable in a material way. Their lives are industrious, quiet, uneventful, conservative. ¹Guppy says: "It was the boast of a wealthy old Devonshire yeoman, 150 years ago, that he had never crossed the borders of his native country, and I cannot believe that in this respect he differed greatly from his fellows. . . . This gave solidity of character to which the long persistence of families in the same locality and in the same stations is mainly due." They love order, fond of systematic work, and believe that there is a virtue in doing things at fixed times. Some spend life happily in one place tinkering and puttering away at odd jobs. Cases 50, 54, 55 and 56, represent a large class that make few friends, retiring in disposition; dread meeting strangers, entering a new place, or even sleeping in a strange bed; are in constant dread when among strangers either of *boring* some one or getting *bored*. They have more fears than rovers and gad-about. Although they shun crowds, hospitality and open friendship are found at their homes. Many are fond of company, and delight in the duties of hostess.

Habit, born of necessity, doubtless explains much of the phenomena. Some are suddenly and almost pitifully attached to their homes through some shock occasioned by a death in the family (case 48), or by sickness contracted away from, or by some other unexpected misfortune. They come to feel that to leave home will in some mysterious way precipitate a dire calamity. This feeling and nervousness often becomes so intense at leaving that the journey is abandoned. Thus sorrow and disappointment may greatly intensify the home feeling. The dread of meeting persons, shunning the effort to bear up the "dead weight" of the presence of strangers, the fear

¹Guppy, H. B.: The Homes of Family Names.

of not being welcome, of injuring some one's feelings indicate, at least, a strong coincidence between the fear of persons and the love of home. Dr. Hall¹ finds that the fear of persons ranks third, exceeded only by the fear of thunder storms and reptiles.

They may grow homesick or timid or their resolution to stay away may break down at the approach of night. They are afraid "mother might die" (case 56); something "at home might go to ruin" (case 57); "something fatally done" (case 45), or that they will never see home again, that they themselves may die that night. One after returning home examines every shrub and flower in the yard to see if they are unharmed (case 34), another goes straight to her room to see if all her things are as she had left them, and so on. May not this unusual unrest and anxiety about home and its belongings be a remnant of the bitter and costly experience that man along with so many other species must have suffered through the neglect of properly guarding or hiding the home.

Many species of life must have had some such experience, otherwise the origin of the widespread instinct to post sentinels or place some obstacle in the way of approach to the home is still unsolvable.² The home of whatever species, being the center of family possessions has always been the one tempting object for attack and pillage. Even civilization like modern frontier life is not without its lessons of wrecked homes in the absence of its natural protectors. It would be a wonder if these bitter experiences during the evolution of the home from the ill-provised tent of the nomad to the modern brown front had left no trace upon the soul.

The feeling of comfort and ease based on habit,³ familiarity and freedom is nowhere fostered as in the home. The feeling that our ways are better ways, the difficulty to adopt one's self to other ways of life than those learned in childhood are just so much data on the general laws of habit. It weds every one of us to the manners, nooks and crannies, hills, valleys, lakes and forests of our own home and neighborhood. The sense of familiarity so frequently mentioned is but a function of habit. We like the feel of things, welcome under all circumstances, the "warmth and intimacy," the naturalness of home relations. What is this naturalness but a maximum reduction of friction through habit? Along with familiarity runs a deeper

¹ Hall, G. Stanley: *Amer. Jour. Psy.*, Vol. VIII, No. 2, 1897.

² Ants, bees, species of fish like the stickle back, species of birds, monotremes, prairie dogs, many herbivorous and several species of monkeys post sentinels to give the danger signal or do battle for the home when attacked by the enemy.

³ James, William: *Psychology*, Vol. I.

feeling, that of freedom. At home I can do what I like, have a chance to relax and feel easy, and throw off conventional restraint.

The fact that natural scenery ranks next to members of the family as a factor in the love of home justifies further investigation—far more than this paper contemplates.

There is little doubt now but that "gods¹ of the early world are the rocks and the mountains, the trees, the rivers, the sea." The primitive mind did not even distinguish animate from inanimate objects, but both alike possessed life, passions and spirits. Along with this belief in the general animation of everything went the belief in metamorphosis. Their gods were creative. "In Greece² the stories of the descent of man from gods stand side by side with ancient legends of men sprung from trees or rocks, or of races whose mother was a tree and their father a god. Similar myths, connecting both men and gods with animals, plants and rocks, are found all over the world and were not lacking among the Semites." In addition to being objects of worship, trees, rivers and mountains have always been favorite places for worship. The word kirk, now softened into church from quercus oak, indicates early religious use of trees. Preferences for certain waters in rituals is evidenced by Naaman's indignation when he was told to bathe in the Jordan instead of the rivers of Damascus. Again we read: "The hour cometh when ye shall neither worship in this mountain"

The application of flowers and plants to ceremonial purposes is of the highest antiquity. Of forests Coulter³ says: "There is solemnity about them, a quiet grandeur, which is very impressive, and the rustling of their branches and leaves has that mysterious sound which caused the ancients to people them with spirits. We still recognize the feeling of awe that comes in the presence of forests." Rivers and springs, trees and plants have long administered to the ills of man. The mountains have furnished him shelter from storms and enemies. The feeling of the child and adolescent for stream and forest has already been indicated. Truly, the race has lost none of its attachment for these archaic friends.

The love of home viewed from the standpoint of nostalgia adds emphasis to matter already presented and gives renewed interest to somewhat old psychological problems. Some typical cases of nostalgia are presented, taken from 176 reports on that topic. Six per cent. of the members report as having never been homesick. Eighty-seven per cent. are females. This

¹ Fergusson: *Tree and Serpent Worship*, p. 54.

² Smith, W. Robertson: *The Religion of the Semites*, p. 86.

³ Coulter, J. M.: *Nature and Art*, Vol. I, p. 1, 1898.

large percentage I think is due to the fact that eighty-six per cent. of those that answered the syllabus were females. No sharp line can be drawn between loneliness and homesickness. The latter is oftentimes preceded by a brief period of the former.

1. M., 4. Whose parents had moved to a new neighborhood, said even before the house furniture had been put in order, "Let's take the cows and go back home."

2. M., 5. Became very lonely and homesick to return to the old home from which parents had just moved. When questioned why he wished to return, said, "I want to get my playthings." They consisted of a stick horse, a few pebbles and broken dishes.

3. F., 21. "When I first entered school I was homesick for several weeks. If lessons were hard and I found much difficulty in mastering them, I would get a longing for home that would not leave me until after a night's sleep."

4. F., 19. "Have never experienced intense feelings of homesickness, although I have longed to be at home at times when dissatisfied with my surroundings or my work. The feeling wore off with increased interest in my work."

5. F., 20. Experienced homesickness only for a short time and then it was mostly due to lack of employment.

6. M., 5. Went to stay all night with a neighbor only a few rods away from home. Became so homesick that he had to be carried home even in the night.

7. F., 19. "At about eight visited an aunt. At night I would cry myself to sleep thinking of the pleasant ways at home. I felt forsaken and forgotten, worried about accidents that might happen at home. I was afraid some one would die before getting home."

8. M., 21. "At 10 went to spend the night away from home for the first time. Made it all right during the day. At night was seized with a tremendous longing to be at home. I was helping to shell peas, put one in my mouth but could not swallow, I felt so badly. Without saying a word put on my hat and walked home two miles in the dark."

9. M., 19. "Could not eat, whenever I would try I would choke up. Felt sick all over. Did not want to say anything—was thinking of home all the time—could not think of anything else. There was sort of a smarting sensation in my stomach, and I *felt faint*."

10. F., 18. (First term in boarding school.) "I *felt dazed* and for a long time I could not realize why I was where I was."

11. M., 24. "I cried every day for three weeks about sundown. I could not tell why I cried, for I had been very anxious to go away to boarding school and would not have gone home had I had the opportunity."

12. F., 10. "I used always to get homesick if separated from my mother; but if she left me at home, it was not so bad as when I left home—suppose the familiarity of home surroundings lessened the sickness."

13. F., 22. "At 12 while in school became homesick and finally ill. The physician said there could be no marked improvement while I remained from home, as that was my one thought. I had not been home but a few hours when I ate a hearty meal and slept well, and in one week was well again, while the day I came home I had to be carried up stairs."

14. "All new girls at this school were placed in the back part of the hall, which was dark and gloomy. Looking out of my window I

could see any number of tin roofs, chimneys, back-yards, and servants passing in and out. These sights together with the coldness of the older students made me dreadfully homesick."

15. F., 22. At seven stayed away from home a week, could not eat anything and was always looking to see some house or scenery that *looked like home*.

16. F., 10. Was sent away to a school for girls—she was eager to go. Enjoyed the change at first but soon gave way to extreme homesickness. At the end of three months of school life she had become really ill—was very thin, ate almost nothing, had a heavy cough and was believed to have consumption. She was sent home and recovered in a few days.

17. F., 18. "Got along well during the day, but at nightfall would choke up and when the crickets, the "Katydids" (cicadae) and the low wind began to make a noise I broke down and cried myself to sleep."

18. "I was homesick once, at home, too,—(father and mother had gone away for some time). I was all alone in the old house. The feeling was similar to *nausea* only in a less degree with such a longing for some one to come."

19. F., 18. "I lost my appetite, could not be comforted, did not wish to talk, would get *dizzy* when I walked across the floor."

20. F., 23. "Do not lose my ambition to work but feel doleful, lose my appetite, so that I almost come down sick. Have a bad feeling all the time in the region of my stomach which ceases with the homesickness. I think homesickness is the most appalling thing under the sun. It swoops down on one before one knows it and you cannot get rid of it."!

21. F., 17. "An indescribable longing. I seemed sick all inside myself and all choked up."

22. F., 18. "I would always get sick at my stomach and often vomit. My family would laugh at me when I reached home and say it was homesickness. There is a feeling of pain, as well as I can locate, a little lower than my heart."

23. F., 30. "I always have a smothering sensation—everything seems closing in on me."

24. M., 22. "I feel melancholy, down hearted. There seems to be a lump in my throat—I feel that a good cry would help."

25. M., 23. "I lost both appetite and weight, had to give up work and go home."

26. F., 25. "My dreams of home make me homesick."

27. F., 18. "I felt unloved and unloving to all around me and could only conceive of happiness at home."

AGE. Forty-three per cent. of these cases (166) occurred for the first time at ages 16, 17 and 18 years. Eighty per cent. occurred for the first time from ages 12 to and including 18 years. The large number occurring at 16, 17 and 18 is due to the fact that conditions for homesickness were presented for the first time at these ages, *e. g.*, entering school or college, taking a new position, entering the navy or army.

Hack Tuke¹ thinks there are no general rules for its occurrence in the different sexes, ages and temperament. Papillon² says: "Nostalgia attacks by preferences, young people and

¹Tuke, Hack: Dic. of Psy. Medicine, Vol. II, p. 858.

²Papillon, Fernaud: Pop. Sci. Month., Vol. V, pp. 215-20, 1874.

those just entering youth, affecting all temperaments without distinction."

"Adolescence is really the age for predilection to nostalgia," says Vidal,¹ "It is the age of delusion and of love. The young man is still under the influence of his childish memories which dispose him to recall the place where he has been happy and to magnify the charms of native land as soon as he encounters the first deception of life." An army² surgeon writing on the evils of youthful enlistment, and nostalgia says: "Among young prisoners of war it is the most complicated disease to be encountered." Both the French and German army surgeons confirm this view; and all agree that fresh *youthful* troops from *rural* districts are often a positive hindrance to the efficiency of an army because of their predilection to homesickness. Vidal believes that there are vague signs of it in babyhood. "Although this affection may be incompatible with the infant, it is none the less true that, instinctively the nursing child is affected by all that surrounds it, and the tears which it sheds when one changes its food or removes its rattle are already vague feelings of nostalgia." My impression, based on medical literature and other material, is that in quality or intensity (cases 9, 25) nostalgia is just as severe and if allowed will lead to as fatal results before and after as those cases occurring in adolescence but that the latter is more predisposed to an attack than either childhood or manhood.

SEX. Tuke thinks no rules can be laid down regarding its relations to sex. Vidal thinks woman is less subject to nostalgia than man because she can enter into new conditions and receive new influences without herself suffering any great change. This notion squares with the general theory that she is more conservative than man. "Whatever may be the migration of woman her manner of life is less changed and like the ancient wanderers she carries her household gods with her." These are the reflections of a French army surgeon who had studied nostalgia in camp, prisons and hospitals, all three presenting the pink of conditions for the ravages of the disease. Had he been a physician to a cotton or woolen factory, a female boarding school, or a modern normal school, it is probable that his notions would have been considerably modified.

While the present study (eighty-seven per cent. females) indicates that women are more liable to the sickness, I hesitate

¹ V. Vidal: Dic. Eng. des Sci. Medicales, pp. 357-380.

² Peters, DeWitt C. (U. S. A. Surgeon): Am. Med. Times, Vol. VI, 1863.

in the absence of a wider range of data to draw any conclusions on this point.

Temperament and Nationality. It is generally agreed that the most diverse temperaments pay equal tribute to nostalgia, so that an attempt to make any classification on that basis is of no value. I find, however, that the majority of the cases are sensitive, not a few nervous, timid, sociable, affectionate; but they fear a crowd, dread meeting strangers, delight in the simplicity and shelter of domestic life. Another class occurring often enough to mention is the phlegmatic, the taciturn. They are described as "difficult to entertain," "prefer to be by themselves," "interests are odd or provincial." They move in a self-created world. With but few exceptions the cases are Americans of Anglo-Saxon stock. A few pitiful cases of foreigners unable to speak our language are reported.

A French writer says: "That every one imagines that his native soil is distinguished from others by signal favors, by particular and rare attributes, and that nature has need of this illusion in order to keep each man in his own home." Vidal thinks that the predilection to nostalgia is inversely to the degree of civilization of a people. Sagos, quoted by ¹Papillon, says "that love of country is strongest with those who are nearest to a state of nature." Savages living under the rudest forms of civilization, in the most uninviting climates, grieve when they quit them. A Lapp brought to Poland where every kindness was shown him, was seized with incurable sadness, and at last escaped and returned to his inhospitable country. Greenlanders taken across to Denmark risk certain death by trusting themselves to slight canoes to cross the ocean separating them from their own land. Pocahontas, fondled and caressed by London society, grew homesick for Virginia's woods and finally wasted and pined away. The Psalmist² records Israel's yearning for their Judean homes while captives in Babylon. "By the rivers of Babylon, there we sat down, yea we wept, when we remembered Zion. We hanged our harps upon the willows in the midst thereof. . . . How shall we sing the Lord's song in a strange land?"

Nationality. Switzerland is the classic land of nostalgia. The love of freedom and independence of the inhabitants, their love of family life, the pure air of the mountains, the charming scenery of which the accentuated outlines become etched into their very souls are all elements that make for love of home. Next come the French. The disposition to the disease diminishes roughly in proportion as one advances toward the middle of the country³ (France).

¹ Papillon, Fernand: *loc. cit.*, p. 218.

² Psalm CXXXVII, Verses, 1, 2, 4.

³ Based upon thousands of cases in French military hospitals.

English and Germans leave their country with less reluctance than the citizens of other countries. More cases occur among German troops in foreign lands than among the English, whose adventurous and cosmopolitan spirit (his country is wherever his flag floats), his commercial predilection immune him from nostalgia without removing in the least his attachment for his country.

Dr. Peters¹ describing the ravages of homesickness among fresh troops quartered in New Orleans (1862), says: "This was notably true of soldiers from New England, where it appeared that the love for home was very strong."

Dr. Calhoun² writes: "It is a matter of common remark in this army that troops from the country have a much larger percentage of deaths than those recruited in the cities." He thinks that the peculiar susceptibility to nostalgia of those from rural districts is due to the fact that a country boy is more at home, seldom takes his meals at other than the family table, seldom sleeps away from home, has less temptation to leave it, and thinks more of it and its influences than he who in the city spends his days in the workshop or counting-room, and his nights at the thousand and one places of amusement a city affords; then, too, the city boy gets his meals at the restaurant or the boarding-house.

Facilitating Conditions. By these I mean the variety of conditions in which nostalgia occurs and the factors that may aggravate it. Fifty per cent. of the cases reported occurred on entering school—even the first day of school. Others occurred while making a visit in the country from the city, or *vice versa*, or in beginning the first school, taking a new position among strangers, moving to a new neighborhood, to a foreign land, being left alone at home, taken sick away from home; again seeing or meeting some one from home, or even receiving a letter, is sufficient at times to touch off the pent-up feelings.

Idleness, the mother of a motley host of delinquent offspring, is exceedingly prolific in this disease (case 5). Among soldiers³ and sailors, idleness, coupled with suspense and lim-

¹ Dr. Peters: *loc. cit.*, pp. 75-6.

² Calhoun, Th. J.: Nostalgia as a disease of field service. Medical and Surgical Reporter, Vol. XI, p. 131, Phil., 1864.

³ In military life the beginning and the close of service is marked by increased nostalgia. "When I took charge of the division they were losing men by death daily. That it was not due to local causes was proved by the fact that adjoining regiments exposed to the same local influences, lost none, and of the patients at our division hospital, with the same diseases (typho-malarial fever and camp dysentery), those from the 120th N. Y., Vols. died under the same treatment that the others got well on. The regiment is from one of the river counties

ited freedom, is more than the ordinary soul can endure with equanimity. It wrings the cold sweat from the stoutest.

According to my returns nightfall exceeds all other elements in aggravating and intensifying the sickness. (Cases 12, 16, 18, 23, 35.) The stillness of the night, the chirping of crickets, the whispering of the leaves, the sough of the wind, new and strange noises, real or imagined, all intensify the gloom and forsakenness of the unfortunate. Dr. Hall's¹ study of Fears emphasizes the wonderful horrors that night holds in store for so many, even though surrounded by every comfort and protection. Less frequent aggravations are the reception of letters and articles from home; dreams about home; the feeling of goneness on facing the real after awakening; friends offering sympathy; hearing a familiar song. So strong and disturbing was the influences of a certain air on Swiss soldiers in the service of the French that it was forbidden to be played in their hearing.

Psychical Effects. It usually begins by feeling lonely, desolate, forsaken. "Longing for a lost past," "low spirited," "loss of ambition," "hard to cheer up," "no interest in surroundings." Desire to please, natural coquetry and regard for the opposite sex disappear. Some report: "I wanted to cry;" "wanted to scream;" "cried most all the time;" "cried myself to sleep;" "could think of nothing but home;" "thought all the time on objects at home;" "felt as if I would go insane." Sometimes it comes very suddenly. "It swooped down on me;" "felt as though everything was closing in on me;" "there is a smothering sensation;" "feeling of utter despair came over me all at once." They may become iconoclastic. "Wanted to destroy everything in my way;" "had no mercy on man nor beast until I reached home." In its last stages hallucinations and delirium set in, followed by complete prostration, stupor, syncope and death.

Bodily Phenomena. The three most general, if not universal effects, are (1) loss of appetite, (2) gastro-enteric troubles, (3) irregularity in respiration interrupted by sighing. Vague, erratic pains—variable in intensity—accompany all the symptoms, and become more and more localized in the head and stomach. Vomiting often begins early (case 31), the same is true of animals—the eyes become more and more fixed, dull,

of New York state. Nearly all who died were farmers. Those who were sent on furlough got well, while those who remained died. But a still further proof is present. The battle of Chancellorsville cured the regiment, and it has since enjoyed as good health as any in the division. This leads me to the remark, that BATTLE is to be considered the great CURATIVE AGENT of nostalgia in the field." Theodore J. Calhoun, *loc. cit.*, pp. 131-32.

¹ Hall, G. Stanley: *loc. cit.*

and languid and sunken in their sockets. The face is anemic, the whole body begins to emaciate; the pulse is irregular and weakened, heart palpitates, temporal arteries throb. The mouth is dry and sticky. Nervous dyspepsia is very common, more often accompanied by diarrhoea, sometimes by constipation, ending in an absolute refusal to take food. There is incontinence of urine, spermatorrhoea, menstruation may be checked or suppressed altogether. Sexual functions are dulled. Pulmonary phthisis is sometimes mistaken for consumption (case 16). In a word, anabolic processes gradually approach a minimal activity, while the katabolic hasten to the maximal.¹ Sagar says: "It appears that the soul of the nostalgic no longer resides in the body, that it has broken off all commerce with it. All, however, agree to a general bodily phthisis sometimes more or less pronounced in the lungs.

The foregoing² facts and considerations impress one that nostalgia is a very fundamental reaction of an organism to fairly describable groups of stimuli. These groups are *primarily*, it seems to me, the absence or loss of the FAMILIAR, the presence of the STRANGE and UNTRIED, and *secondarily* restricted liberty, change of food, habits of life and the like. The first group, especially, will engage us here.

Cases like 9, 10, 18 and 19 have suggested, what appears to be a probable solution — at least a point of view permitting legitimate speculation. Faintness, a dazed feeling, nausea and dizziness are the well known disorders of seasickness and vertigo.

Seasickness³ is caused by a derangement of the nerve centers that control the equilibrating mechanism of the body. The sense⁴ of equilibrium is furnished by every possible bodily sensation — both kinæsthetic and sensory. To retain⁵ this sense, it is necessary that the information, derived from whatever source, should harmonize. Disturb the harmony and vertigo immediately ensues. Contradictory impressions not only disturb but often stop the equilibrating functions. Nowhere are these confused sensations so baffling as at sea. The point of

¹ Physicians, like Haspel and Larrey, believed that it was caused on the physical side by brain and spinal lesions, cerebral hemorrhages and swellings of the arachnoid membrane, or by gastro-enteric lesions. These views are now discredited.

² Calhoun says "Nostalgia is an affection of the mind. It must be treated with that in view." Hack Tuke thinks that it always represents a combination of psychical and bodily disturbances. Sauvage describes it by four words: *morasitas*, *pervigilio*, *anorexia*, *asthenia*, which signify sadness, sleeplessness, want of appetite and exhaustion.

³ Hudson, W. W.: Cause, Nature and Prevention of Seasickness.

⁴ Howell: Amer. Text Book of Phys., pp. 846-47.

⁵ Elsner, H. L., Dr.: The Medical News, Vol. LX, pp. 477-80, 1892.

rest (center of gravity) in the human body on a tossing ship is being constantly shifted. Persons unacquainted with these phenomena attempt consciously and unconsciously to make compensatory movements in order to maintain the old habitual land-sense of equilibrium ; thus inaugurating a struggle between equilibrium of habit and the equilibrium under novel conditions (sailors are adjusted to this novel sense of equilibrium). These repeated attempts to maintain an *arbitrary* center of gravity as it were, produce seasickness¹.

Nostalgia, it is true, is not a direct disturbance of the physical sense of equilibration, it appears as a secondary effect. The patient has, however, lost his psychical orientation. Just as the seasick patient has his center of gravity and consequently his physical plane of reference constantly eluding his bodily adjustments, so the nostalgic has his "psychical plane of reference" — composed of familiar scenes, friends, sense of security and the like — rendered uncertain and bewildering, through his inability to interpret and to enter into familiar relationships with the new world about him. To get on in this new world new adjustments must be made, old brain paths must be dropped and new ones formed. He must fuse with a new stratum. The greater the unfamiliarity the severer will be the nervous shock and stress in trying to make a new adjustment, or to establish new relationships. As we have seen, many do not try to make a "fusion" at all, do not seek a new "plane of reference," do not attempt to build new brain paths, but rather yield passively to their prison-world with wonder, timidity and fear. One experiences the beginnings of this phase of nostalgia on entering a familiar room in which the furniture has been rearranged or a piece taken out, or when one attempts a mechanical performance in a new situation, *e. g.*, writing or eating in a new place at the table, or when one looks into the garden or on the lawn where a conspicuous tree has been cut down.

The shrivelling and contracting effects of nostalgia on the ego are unique. Especially does this seem true of the social ego. In a strange land no one appreciates, applauds and sympathizes with my efforts, my boon companions are gone, I am isolated, cut off, but a mere machine grinding out a bit of the world's work.

MIGRANT VS. LOVER OF HOME.

The migrant is cosmopolitan, has manifold interests, and finds profitable objects and kindred spirits in a variety of situations.

¹ For a detailed description of the anatomical and functional relations of the organs (believed to be) involved in vertigo. See Dr. E. Woakes, *Brit. Med. Jour.*, Vol. I, pp. 801-41, 1883.

McBride: *Medical Times*, London, 1881.

H. S. Lee: *Jour. Phys.*, Vols. XV and XVII, 1894-95.

Howard Ayres: *Jour. Morph.*, Vol. VI, 1892.

He may be found in the commercial, speculative, daring, progressive, macroscopic interests of the world. The lover of home is provincial, plodding and timid. He is the world's hod-carrier. His interests are identified with the conservative and microscopic affairs of society.

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THE APPLICABILITY OF WEBER'S LAW TO SMELL.

By ELEANOR ACHESON McCULLOCH GAMBLE, Ph. D.,
Cornell University.

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SUMMARY AND CONCLUSION.

INTRODUCTION.

So long ago as 1834, in a paper entitled "De Tactu," Ernst Heinrich Weber first stated the law which bears his name, the first law of psychophysics. Working by the method afterwards called by Fechner "the method of just noticeable differences," he had discovered the law in its application to pressure and strain.¹ Before 1860 it had been proved to hold also for noise and brightness. Since the establishment of the first psychological laboratory, which occurred in the academic year 1878-9, and, oddly enough, but a few months after Weber's death, the validity of the law for the four sensation qualities mentioned has been over and over again confirmed.

Before 1860 Volkmann, Renz, and Wolf, by the method of minimal changes, had proved its applicability to noise. Bourger, Fechner, and

¹ Wundt: *Physiologische Psychologie*, 4th ed., I, p. 381.

Volkman, by their "shadow-experiments," and Masson with his rotating disks, had shown its validity for brightness. Fechner had also established Weber's conclusions in regard to strain by the method of right and wrong cases. In the last twenty years, Tischer, Merkel, and Starke, by the method of minimal changes; Merkel and Angell by the method of mean gradations; and Lorenz, Merkel, and Kämpfe, by the method of right and wrong cases, have confirmed for noise-intensities the results of Volkman; Helmholtz, Aubert, and Kräpelin have established for brightness the results of Masson; and Merkel, using the method of minimal changes, has also proved the conclusions of Weber and Fechner in regard to strain. In the last six or seven years, the experiments of Merkel by the method of average error have proved the extension of the law to those strain-sensations in terms of which we measure distance by the eye, and the experiments of Schumann by the same method give some indication of its extension to strain-sensations involved in our estimate of intervals between one-half second and three seconds.

In case of the sensation-modalities for which the law has not been proved, and in the case of tone, there are great difficulties in graduating the intensity of the stimulus. Articular sensations, indeed, are not themselves graduated intensively. In the case of tone, the difficulty is mechanical,—that of graduating minutely the objective intensity of simple periodic vibrations. In the case of the two temperature qualities, which are peculiar in depending on different intensities of a stimulus from a physical point of view the same in kind, and in passing into each other through a conscious indifference-point, the extreme adaptability of the so far unknown and inaccessible peripheral organ makes the intensity of the physiological stimulus begin to fall towards the indifference-point upon the application of any new physical stimulus, and thus prevents the physical stimulus from being a measure of the physiological. The sensation, moreover, varies in intensity with the extent of surface stimulated and with the weight of the stimulating body.

The qualities of taste and smell form manifolds of indefinitely related terms, which must be investigated separately. In the case of taste, the list is at least closed. The intensity of the taste sensation, however, is a function (1) of the degree of saturation of the solution tasted; (2) of the magnitude of the area excited; and (3) of the movement, diffusion, and pressure of the substance tasted within the buccal cavity. No very satisfactory way of keeping all but one of these factors constant, while that one is varied, has as yet been found, though the investigations of Camerer, who worked by the method of right and wrong cases, make the law of Weber appear to apply to salt and bitter.

As for the applicability of Weber's law to smell, the object of this paper is to offer a mass of experimental difference-determinations, with a statement of the "checks" or controls to which they must be subjected. This enumeration of possible

errors involves a discussion of the essentials of a satisfactory olfactometric method, and a detailed description of the method and apparatus actually employed. The literature of difference-determinations in smell amounts practically to pages 180-181 and pages 188-194 in *Die Physiologie des Geruchs* of Dr. H. Zwaardemaker, now professor of physiology in the University of Utrecht. The work was translated into German from Dr. Zwaardemaker's manuscript by Dr. A. Junker von Langegg, and was published in Leipzig in 1895. The experiments to be described are in the main a realization of suggestions of Dr. Zwaardemaker's, of which some are contained in his book, and some few were made in personal letters. The olfactometric method used was, of course, his. This method was first applied in 1888, and is now familiar in most psychological laboratories. To quote from *Science*, XV, 44: "Dr. Zwaardemaker of Utrecht has constructed an instrument which he calls an olfactometer. It consists simply of a glass tube, one end of which curves upward to be inserted into the nostril. A shorter movable cylinder made of the odoriferous substance fits over the straight end of this glass tube. In inhaling, no odor is perceived so long as the outer does not project beyond the inner tube. The farther we push forward the outer cylinder, the larger will be the scented surface presented to the intruding column of air, and the stronger will be the odor perceived."

We are indebted to Dr. Zwaardemaker for the words "olfactometry" and "olfactometer" (replacing the older "osmometer"), "odorimetry" and "odorimeter." Olfactometry is that branch of psychophysics which is concerned with the measurement of the keenness of smell.¹ The distinction between the keenness and the delicacy of smell must be kept in mind. On the delicacy of smell depends the discrimination of olfactory qualities. On its keenness depend the bare sensing of odors and the discrimination of them as more or less intense.² Odorimetry is a "side-issue" of olfactometry. It is concerned not with the sense-organ, but with the measurement of the intensity of smell-stimuli considered as objectively as possible.³ For the unit of keenness of smell, Zwaardemaker uses the word "olfactus," and for the normal stimulus-limen for each odorous substance he employs the companion word "olfacty."⁴ If, for example, a subject's stimulus-limen on the olfactometer is 10 mm. when the normal stimulus-limen used is

¹ *Die Physiologie des Geruchs*, p. 78.

² P. 11. Cf. also Vintschgau, *Die Physiologie des Geruchsinnes und des Geschmacksinnes*, in Hermann's *Handbuch der Physiologie*, III, 2, p. 270.

³ Zwaardemaker: *op. cit.*, p. 174.

⁴ Pp. 92, 134-135.

5 mm., then his stimulus-limen is two olfacties, and his olfactus $\frac{1}{2}$. The olfacty used by olfactometry becomes for each substance the unit of odorimetry. Odorimetry is correlated with photometry and phonometry. Both olfactometry and odorimetry are branches of "olfactology" (to anglicise another word used by Dr. Zwaardemaker). This again is correlated with optics, acoustics and haptics.

The interdependence of olfactometry and odorimetry is not unique. The unit of photometry, *i. e.*, the unit for the measurement of light in the physical sense, is the illuminating power for sensation of the light of some standard candle. "We have no adequate objective method," writes Prof. Külpe, "of ascertaining the intensity of the non-periodic and aperiodic concussions which form the substrate of simple or complex noises, independently of the statement of the observer whose sensitivity we are testing. The phonometric determination of sound intensities in psychophysical experiments is usually carried out upon a principle similar to that employed in photometry. As the objective stimulus-values in the apparatus employed,—say, elastic balls falling from a measurable height on a resisting plate,—are determined by way of a subjective comparison, the results are purely empirical, valid only for the material used, the special circumstances of the observation, etc."¹

The peculiarly unsatisfactory character of the determinations of olfactometry and odorimetry is due chiefly to the fact that olfactory qualities, unlike visual and auditory, are not demarcated. It is true that it is more difficult to keep uniform the duration and extension of smell-stimuli than it is to regulate these attributes for other stimuli, with the possible exceptions of temperature and taste. It is also true that the great gulf of psychophysics, our ignorance of the physiological processes which everywhere link the strictly physical to the psychological, is wider in the cases of temperature, taste and smell, than in the cases of vision, audition, pressure and strain. Yet, at best, the measurements of physics must always be in terms of sensation, and the measurement of sensation must always be in terms of physics.

It seems wise to emphasize at the outset the initial difficulty which makes all quantitative work in smell more or less unsystematic, *viz.*, the indeterminateness of olfactory qualities. It is at present necessary to regard as a simple and separate quality the odor of every substance which from a physical point of view is unmixed ; yet, for several reasons, it is un-

¹ *Outlines of Psychology*, tr., p. 156.

likely that there are as many elementary odors as there are simple substances.¹

One reason is, that it is extremely improbable that either the structure of the fibres or endings, or the substance of the olfactory nerve, is differentiated to correspond to the innumerable odorous substances which we encounter; and, on the other hand, it is probable by analogy with other sense-organs, that there are "specific energies" of smell which are limited in number and capable of combination.²

A second reason is that we have experimental evidence that the action of the sense organ is differentiated into more and less separable processes. We have sure evidence in the results of exhaustion-experiments, which were first instituted by Frölich and Aronsohn.³ For example, a subject whose organ is fatigued by the continuous smelling of tincture of iodine can sense ethereal oils and ethers almost or quite as well as ever, oils of lemon, turpentine and cloves but faintly, and common alcohol not at all. We have also evidence of some slight value in the recorded traces of partial anosmia.⁴ Unfortunately, very few such cases have been described by persons who took experimental precautions, and such cases as are noted in medical literature fail to show typical anomalies comparable to the uniform phenomena of color-blindness or "tone-islands," which have played such an important part in the formation of theories of vision and audition.⁵

A third reason is that there are countless instances of smell-fusions in which the components cannot be detected. Nagel intimates that there is no proof of the existence of smell-fusions in which different components can be sensed as different at the same instant, and points out that, in this respect, smell-mixtures resemble color-mixtures rather than clangs.⁶

Zwaardemaker, following Aronsohn and bearing in mind the usages of the perfume trade, holds that only similar odors will

¹It should be noted that the words "simple" and "mixed" or "compound" are used here in the sense of physics proper, and not in the sense of chemistry. Smell, in the physical sense, is undoubtedly a property of the molecule, not of the atom. Indeed, most of the elements are odorless. Sulphur and hydrogen, themselves odorless, form sulphuretted hydrogen, one of the most offensive smelling gases known.

²Nagel: *Über Mischgerüche und die Komponentengliederung des Geruchsinnes. Zeitschrift für Psychologie und Physiologie der Sinnesorgane*, XV, pp. 82-83.

³Zwaardemaker: *op. cit.*, pp. 203, 204, 256-257. Aronsohn: *Untersuchungen zur Physiologie des Geruchs. Archiv für Physiologie*, 1886, pp. 342-346.

⁴Zwaardemaker: *op. cit.*, p. 259 sq.

⁵Nagel: *op. cit.*, p. 87.

⁶Pp. 90-91.

mix.¹ He believes, on the basis of his own experiments, that if dissimilar odors of different intensities are mixed, the weaker odor will cancel part of the odor of the stronger, and will itself be lost, and that if dissimilar odors of the same intensity are mixed, both will disappear or will give but a feeble indeterminate fusion.² Zwaardemaker does not, as alleged by Nagel, adduce his conclusions in regard to mixture as a buttress to his localization and irradiation theory, though he does seek to explain the facts of mixture and compensation, as he understands them, in harmony with this theory.³ Nagel, as opposed to Zwaardemaker, believes, on the basis of his own experiments, that any two smells will unite in a mixture which for an instant, at least, will make a simple impression of new quality.⁴ He has never found an instance of complete "compensation," but he agrees with Zwaardemaker that a mixture of several smells is in general weaker than its individual components, and that some combinations of strongly odorous substances are almost odorless.⁵ Nagel offers no explanation of the phenomenon of compensation, nor does Zwaardemaker explain it satisfactorily even on the basis of his irradiation-theory. Perhaps it is safe to conclude that most smells will mix. As Nagel suggests, there is no occasion in the perfume trade to mix nauseating or hircine smells with the odors of flowers, spices and resins.

A fourth and final reason for believing that there are not as many simple odors as there are unmixed substances, is that many simple substances have been found by experiment to have composite odors. Chlorphenol and nitrobenzol are good examples of such substances.⁶

Now, if there are a limited number of specific energies of smell, and if most smells are mixed, our ignorance of the elementary smells, and our consequent inability to isolate them, have serious consequences for the value of olfactometric work. This will be clearer if we consider the two methods which are used to discover whether a smell is simple or composite. The method of Passy consists in gradually increasing the dilution of odorous substances, and depends upon the principle that since the stimulus-limina of different odors are different, they must disappear successively as the intensities of the different stimuli are diminished equally.⁷ However, it is at least possible that

¹ *Op. cit.*, p. 280.

² Pp. 167 and 284.

³ P. 279.

⁴ *Op. cit.*, 95.

⁵ P. 101.

⁶ Pp. 96-97.

⁷ P. 96.

odors which have very different stimulus-limina should have the same difference-limina. The other method is that of exhaustion, and depends on the fact that different odors exhaust the organ with different degrees of rapidity, so that a compound odor, continuously smelled, will alter in quality as first one and then another of its constituents disappears. One may smell continuously the substance to be tested, or may smell it before and after smelling repeatedly an odor very similar in quality. The principle of the method is the same in both cases. The permanency of the mixed odor depends primarily on the equality of rate at which its different constituents fatigue the organ. The more numerous the constituents, the more permanent the quality of the mixture. This fact is well recognized in the perfume industry. Fortunately for the trade, the odor of almost every flower (Sawer mentions jasmine as a unique exception)¹ may be simulated by compounding the odors of other flowers. The odor of violet, for example, is given by a blend of the odors of acacia, rose, Florentine iris, tuberose and almond. The odors of most flowers, again, are possessed by certain chemicals. To the mixture is usually added some substance, such as styrax, amber, or vanilla, which evaporates slowly, and smells strongly enough to compensate parts of the other odors. This is done that quantities of the other odorous substances large enough to allow for evaporation may be put into the solution without raising the intensity of the smell to the neighborhood of the terminal stimulus-intensity.² If, now, most smells are mixed, and if mixed smells alter in quality as the organ becomes fatigued, and if different olfactory qualities have not the same limina, then in quantitative work in smell, we are seeking to determine values which are continually changing according to laws which we do not know.

There is no classification of olfactory qualities, which is even provisionally satisfactory from any point of view but a perfumer's. We give to odors the names of the objects which most commonly give rise to them, or to something similar to them. We speak of a "fishy smell" as loosely as Homer, in the days when the terminology of color was in its infancy, spoke of "the wine-hued sea." Yet the name of an odor is clearly and indisputably applicable only to the smell of that object from which the name is taken.³

Giessler's classification of odors may be of value to psychology proper, but is of no value whatever to psychophysics.

¹ Sawer: *Odorographia*, First Series, p. 94.

² Zwaardemaker: *op. cit.*, p. 285.

³ P. 208.

The most satisfactory method of arriving at a classification of smells seems to be the method of exhaustion; but the results so far obtained do not furnish any basis for such a system. Nagel points out as the greatest difficulty in the way that when the organ is fatigued by one smell, its sensitivity does not remain quite unimpaired for one large group of odors, and utterly fail for another group; but on the contrary, is usually more or less impaired for all odors.¹ Analysis by exhaustion is complicated experimentally by the fact that smells do not fall away steadily, but oscillate at the stimulus-limen, as do minimal sensations in other departments. In the case of smell this oscillation depends on slight variations in the rate and manner of breathing, as well as on the ordinary ebb and flow of the attention. The apparent "rivalry" of odors is due to this fluctuation at the limen.² Moreover, it is only the last component of the mixture to disappear, which is ever really isolated by the exhaustion-process.

Zwaardemaker adopts, with some modification, the old classification of Linnæus, which really has only a subjective basis, though Zwaardemaker attempts, without signal success, to give it a chemical one. On the principle that even a most unsatisfactory system is better than none, some pains have been taken in the experiments to be described to procure smells from as many of Zwaardemaker's classes as possible, and to compare results for representatives of the same class and of different classes. Zwaardemaker's classes of pure olfactory qualities are as follows:³

I. Ethereal smells—including all the fruit odors (a class taken from Lorry).

II. Aromatic smells—including all such odors as that of camphor, spicy smells, and the odors of anise and lavender, lemon and rose, and almond.

III. Fragrant smells—including the odors of most flowers, of vanilla, and of such gums as tolu and benzoin.

IV. Ambrosiac smells—including the odor of amber, and all the musk odors.

V. Alliaceous smells—including the odors of garlic, asafœtida, gum ammoniac, vulcanized India rubber, fish, bromine, chlorine and iodine, etc.

VI. Empyreumatic smells—including the odors of toast, tobacco smoke, pyridin, naphtha, etc., (a class taken from von Haller).

VII. Hircine smells—including the odors of cheese, sweat, rancid fat, etc., etc.

¹ *Op. cit.*, p. 86.

² *P.* 98.

³ *Op. cit.*, pp. 233-235.

VIII. Virulent smells—including such odors as that of opium, "Odor cimicis," etc.

IX. Nauseating smells—including the odors of decaying animal matter, of *fæces* and the like.

The pungency of smells is not an olfactory quality, but is due to the excitation of filaments of the trigeminus, which are freely distributed in the Schneiderian membrane. The sensation is more like pressure than smell. When very strong it becomes a tickling, and sneezing ensues. Persons who have congenital or pathological defects of smell are said to have cultivated these sensations by attention to such an extent that they do duty for smells proper.¹ Some smells which are not the flavors of food sensed in expiration, seem to be tastes, as well as smells. For example, we think of the odor of boiling syrup as sweet, and say that curdled milk "smells" sour. This is probably due to early association, which has indissolubly fused certain taste-memories with certain smell-sensations of peripheral origin.² It may, however, be due to the entrance of sapid particles through the nose into the pharynx.³ Smells are often blended with pressure sensations other than pungency and with temperature sensations.⁴ It is probable that there is an element of pain in an impression of pungency, while smells often give a "feeling of weight," pure and simple. Whenever the subjects in these experiments spoke of the heat, taste, pressure, pain, or pungency of an odor, their remarks were carefully noted, on the supposition that such factors in the total impression were disturbing in a quantitative investigation of olfactory qualities proper.

Zwaardemaker's differentiation of the specific energies of smell and localization of their actions on the olfactory mucous membrane is not to our present purpose. We may simply note in passing that he arranges the zones of their operation in horizontal order, since the height to which the air current is carried in the nose makes no difference in the quality of an odor; and that he rather ingeniously places the nauseating and virulent smells farthest back and closest to the pharynx, in a region where they may excite the reflexes of vomiting and coughing by mere irradiation of nervous excitation without the connecting link of central processes; puts the hircine and ambrosiac odors in the middle, on account of the connection of hyperaemia of the "*corpora cavernosa nasalia*" with the blood supply of the generative organs; and locates the fragrant, aromatic and ethereal smells farthest to the front, since the

¹ Pp. 236-237.

² P. 211.

³ Pp. 211-212.

⁴ P. 212.

sneezing-reflex is most easily excited in the anterior portion of the nasal cavities.¹ Nagel's remark that Zwaardemaker's localization-theory leads to "irresolvable contradiction" is not quite clear, but he is certainly right in saying that the theory has no adequate basis. Aside from the lack of experimental evidence, the arrangement of the several zones is too fancifully neat to carry conviction with it; but Zwaardemaker himself emphasizes the fact that the essential part of his theory is simply the arrangement of the operations of specific energies of smell corresponding more or less exactly to the classification of Linnæus on the olfactory mucous membrane in the order of these classes.²

Before bringing these introductory remarks to a close, it may be noted that, aside from any experimental evidence which may be offered, it is probable that Weber's law does apply to such smells, mixed and unmixed, as we daily encounter. In the first place we have the analogy of several other modalities of sensation for believing that the law applies to simple olfactory qualities. In the second place it has never been proved that Weber's law applies merely to unmixed sensations. It has been neither proved nor disproved for clangs, but many experiences of ordinary life would lead us to believe that it does apply to musical chords as wholes. Thus it may apply to smell-fusions as wholes, and approximately correct difference-determinations may be obtained for these wholes even while their character is gradually altering. Since, in the present state of our knowledge, no one can even pretend to be working with simple olfactory qualities, all difference-determinations in smell must proceed upon the assumption of this possibility. Experimental results must be the only decisive evidence for or against the theory, so that it is needless to discuss it farther in this place.

In the third place the distinction drawn by Passy between "insistent" and "intensive" smells, which is based upon a classification of smells in the popular mind and confirmed by other scientific men, is explained by the supposition that Weber's law applies to smell with different values of $\frac{\Delta r}{r}$ for different

qualities. In Zwaardemaker's language, and in the ordinary language of this paper, the smaller the "minimum perceptible" of a substance, the more intense its odor. Passy uses a term, "*pouvoir odorant*,"—which we may translate "insistency,"—for "intensity" in our sense. He says: "*Tout le monde sent que le camphre, le citron, le benzine sont des odeurs for-*

¹ Pp. 262-265.

² P. 265.

tes, la vanille, l'iris des odeurs faibles," though vanilla has an insistency one thousand times greater than that of camphor. Besides this subjective basis of distinction between weak odors, however insistent, and strong or intensive odors, he has five objective differentiae. (1) Weak smells have vague differences of intensity. For example, vanilla and coumarine soon reach a maximum of intensity which cannot be increased. Greater concentrations simply become unpleasant. (2) Individual differences are more evident for weak smells. (3) The daily variations of sensitivity are more evident for weak smells. (4) Exhaustion has more effect on weak smells. (5) Strong smells hide the weak.¹ In view of the first objective difference, Zwaardemaker explains the subjective difference as follows: As the strength of a sensation is estimated by the number of grades of intensity by which it surpasses the liminal sensation, and as the terminal stimulus is by definition that degree of intensity beyond which increase cannot be shown for our human sense organs with our mechanical appliances, it is obvious that odors with large difference-limina must be subjectively weak, and that subjectively weak odors must have large difference-limina. Thus, the very rapid attainment by some smell-stimuli of the terminal intensity would seem to indicate that Weber's law applied to olfactory qualities, and that the difference-limen differed from quality to quality.²

Unfortunately our own experimental results are at variance with the second clause of the theory. They make Weber's law appear to apply to smells as we find them, but show no great variation of Δr from substance to substance. The difference-limina

even of camphor and vanilline seem much the same. If our figures are accepted as trustworthy, some other explanation than the simple one of Zwaardemaker must be found for the distinction of Passy. May it not be that, for phylogenetic reasons, "intense" smells have more affective value, more of what Müller calls "Eindringlichkeit,"³ than have the smells which Passy calls "insistent?" Or may it not be that the smells most useful to human life exhaust the human sense-organ less after many increments than smells less useful do after a few increments, although the increments are relatively equal throughout? The need of some such explanation will be more or less clear as the figures to be offered are more or less convincing.

¹ Pp. 191-192.

² Pp. 192-193.

³ The "Eindringlichkeit" of a sensation depends in part upon its intensity, and in part upon its affective value (G. E. Müller, *Zeitschr. f. Psych. und Physiol. der Sinnesorgane*, X, pp. 25-27).

CHAPTER I. METHOD.

Section 1. Determination of the intensity of the Smell-Stimulus for the Normal Organ.

If all the nervous elements concerned in smell are in a normal condition, and if "compensation" does not come into play, the intensity of an odor depends on the number of odorous particles in gaseous form which are acting on the olfactory nerve-endings at the time. Perhaps it is safe to say that the intensity is ordinarily a function of the number which are acting on the rod-cells of the olfactory mucous membrane.¹ Whether or not individual rod-cells are subject to cumulative stimulation, we do not know, for we do not know even whether the stimulation is chemical, thermal, or electrical,² but we do know that the intensity of the smell seems to depend on the extent of membrane and therefore on the number of rod-cells stimulated,—always supposing that the rod-cells are the olfactory cells proper.

Now the number of odorous particles which act at any given time on the olfactory membrane of the normal nose depends, first, on the quantity of vapor which the fragrant body is throwing off; secondly, on the rate of the diffusion of this vapor; and thirdly, on the manner and rate of breathing. Let us consider these facts separately.

I. *The Quantity of Vapor Thrown off by the Odorous Body.* "Whether" says Zwaardemaker, "odorous particles are set free by evaporation or chemical reaction, the mass of odorous molecules which are given off from a solid body or the surface of a liquid is, *ceteris paribus*, in compound proportion to the time of exposure and extent of surface exposed."³ Zwaardemaker has invented a "genetic unit" for the measurement of odor in the physical sense. It is the number of seconds of exposure multiplied by the number of square millimeters of surface exposed.⁴ It is unnecessary to say that the genetic unit differs from substance to substance. The "other factors" which must remain equal, if the genetic unit of a given substance is to be constant, are the moisture, weight, and temperature of the atmosphere and the amount of ozone present in it.⁵

That heat and dampness affect the intensity of odors is a matter of common observation. Yellow wax smells twice as strong in summer as in winter. Heat promotes evaporation. Dampness also promotes the vaporization of such solids as are

¹ Zwaardemaker: *op. cit.*, p. 7; Foster: *Text Book of Physiology*, 6th ed., p. 249.

² Zwaardemaker: *op. cit.*, pp. 276-277.

³ P. 39.

⁴ P. 26.

⁵ P. 28.

soluble in water, but, on the other hand, retards the diffusion of odorous vapors. The temperature of the laboratory in which smell experiments are in progress should be kept as uniform as possible, and thermometer and barometer readings should be taken whenever the stimulus-limen is determined. Uniformity of temperature was not secured in our own experiments.

II. *The Rate of Diffusion of Odorous Vapor.* Cloquet pointed out in 1821 that odors diffuse in the air as one gas diffuses in another,—gradually, and without interruption by reflection or refraction,—so that if the air is at rest, the strength of a smell will be inversely proportional to the distance of its source, though the speed with which different odors travel varies much.¹ Now the air from which we draw our breath is, under ordinary circumstances, almost never free from currents. For phylogenetic reasons, no gas is odorous which is not heavy enough to remain near its source if undisturbed. Yet the wind may carry such gases for miles near the surface of the ground. Nor can we, in view of the dynamic theory of smell, and of Liegois's theory that odorous particles are largely diffused in the form of tiny liquid drops which afterwards vaporize, unhesitatingly apply the laws of diffusion of gases to smells. Zwaardemaker has, however, proved by a series of experiments that the transmission of odorous vapors in tubes takes place at the same rate for different distances from the source, unless these distances are very considerable.² From an inhaling-tube, all currents of air, except the suction-current created by the inspiration, are excluded.

III. *The Rate and Manner of Breathing.* Not all the air which passes through the nose comes in contact with the olfactory mucuous membrane. The current of air drawn into the nose from without is divided by the lower turbinal bone into two portions. From the stream which takes the direct path to the choana under this bone and along the floor of the nose, no odorous vapor reaches the olfactory membrane. Each nasal cavity is divided by the middle turbinal bone into two chambers. In the upper chamber, which extends from the pointed roof of the nose to the under edge of the middle turbinal bone, the side wall and the septum are almost parallel, and only about two millimeters apart. The olfactory membrane is spread over the upper surface of these parallel walls, forming the *regio olfactoria* of Todd and Bowman. According to von Brunn only the uppermost part of the upper turbinal bone and the surface of the septum just opposite are covered by the ol-

¹ P. 30.

² Pp. 31-34, 39-40.

factory membrane.¹ In ordinary breathing, the highest point in the upper stream is, according to Franke, the under edge of the upper turbinal bone, and according to Paulsen and Zwaardemaker, the under edge of the middle turbinal bone.² In the rapid and violent breathing with expanded nostrils which we call "sniffing," the air is carried about 2 mm. higher,³—i. e., into the forward and under part of the upper chamber. In either case, odorous particles can reach the olfactory membrane only by diffusion, but more of them will penetrate to it in sniffing than in quiet inspiration. The upper chamber is an annex, not an integral part, of the breathing-passage.

Odorous particles probably do not accumulate in the upper chamber. During inspiration, the air in the passages traversed by the current is thinned, and as soon as inspiration ceases, the air in the upper chamber rushes down to the middle meatus, to be renewed from the pharynx during expiration.⁴ If so much odorous matter has been taken in as to saturate the air in the pharynx, we sometimes get a smell in expiration even when we are not eating. Ordinarily, however, the very weak stimulus from the pharynx, coming after the very strong stimulus from without, is not sensed.⁵ Fick, indeed, advanced the hypothesis that when odorous particles come in contact with the olfactory membrane, they are at once dissolved in the thin fluid which covers the bottom of the sensitive hairs, and that when so dissolved, they cease to act.⁶ These particles may, however, accumulate to some extent on the Schneiderian membrane, especially, if it is in a catarrhal condition. Of course, we get the flavor of food only in expiration. The course of the air in expiration is almost the same as in inspiration, but Bidder is probably right in supposing that a smaller amount passes above the lower turbinal bone.⁷

Under ordinary conditions, the more rapid the breathing, the more intense the smell. Sniffing is to be forbidden in olfactometric work, not merely because it carries the air higher in the nose, than does "regular breathing," but because, both by increasing the suction-force and by widening the entrance, it takes more air and therefore more odorous particles into the nose in a given time. The spaces from which air is drawn through the nose are cones with their points at the nostrils. We may see their size and shape in the clouds of vapor formed

¹ P. 6.

² Pp. 46-57, 67.

³ P. 202.

⁴ P. 60.

⁵ P. 62.

⁶ P. 60.

⁷ P. 42.

by our exhalations in cold weather. The spaces from which odorous particles are drawn are portions of these larger spaces. The breathing-spaces are projections of the whole of the nasal cavities; the "fields of smell" are projections only of those cavities from which odorous particles reach the olfactory membrane. They are separated from each other by about a centimeter. In sniffing, through the expansion of the nostrils, the fields of smell become wider than the ordinary breathing-spaces, but as the inspiration is short and quick, they are not so deep.¹

If then the strength of a smell-stimulus is to be measured with some degree of accuracy by the genetic unit, the temperature and moisture of the air, the diffusion-rate of the vapor, and the subject's manner and rate of breathing must be kept as uniform as possible.

As for the compensation-error, there is no intrinsic stimulation of the olfactory membrane as there is of the retina and the ear. Owing to exhaustion, the subject cannot smell his own breath in expiration. He can indeed smell it in inspiration if the current is puffed upward to the nostrils. This fact seems to show that, given the same amount of odorous matter in the air current, we get a stronger smell in inspiration than in expiration. On the other hand, the difficulty of securing an absence of smells from external sources for a subject who has at all cultivated his organ by attention, transcends the difficulty of securing such silences and darkenesses as are satisfactory for experimental purposes. Of course, no substance which, *as such*, is to be used as a test, should be dissolved in an odorous medium, such as alcohol, ammonia, or ether.

Zwaardemaker classes the methods which have so far been employed to find the stimulus-limena of smells as direct and indirect.² By the direct methods the subject seeks to find the stimulus-limen of an olfactory quality in terms of the greatest dilution of an odorous vapor which can give a just noticeable sensation of that quality. By the indirect methods, he seeks to find the stimulus-limen in terms of the smallest quantity of the odorous substance which can be sensed under certain definite and easily procurable conditions. The direct methods aim at absolute results where absolute results are unattainable. "It may be possible," says Zwaardemaker, "to determine the area of an inspiration made in an effort to smell, but the exact ascertainment of the amount of odorous gas which in this inspiration comes in contact with the olfactory cells has so far proved an impossibility."³ The indirect methods aim at relative results, but their procedure is exact. They furnish a

¹ Pp. 68-77.

² Pp. 79-80.

³ P. 80.

basis for the comparison of individuals with reference to their keenness of smell, and of substances with reference to their value for the sense, and thus may indirectly lead to some knowledge of the greatest degree of dilution in which an odorous substance can be detected.¹

The method which Valentin invented in 1848 may be called classical, since it is mentioned in most of the standard text books of physiology. It was direct, and consisted in taking a certain volume of odorous gas and mingling it with a hundred volumes of air, taking a certain volume of the mixture and mingling this again with a hundred volumes of fresh air, and so on until the last mixture gave a just discernable odor. Valentin varied his procedure by allowing the vaporization of smaller and smaller quantities of a highly concentrated solution of an odorous substance in a definite amount of air, or by mingling smaller and smaller quantities of it with a mass of water of a given volume.² It is plain that a certain amount of the odorous substance must adhere to the vessel in which such a mixture is contained, so that the amount of odorous substance taken away from the receptacle for a new admixture will never be so large as the ratio of the gas or liquid removed to the whole volume would indicate, and that this error must increase as the experiment proceeds. As for the use of highly concentrated solutions, it involves two serious disadvantages, the blunting of the sense by exhaustion and the adhesion of odorous particles to objects in the laboratory.³

The invention of no other direct olfactometric method is recorded before that of the method employed by Fischer and Penzoldt in 1887. Avoiding Valentin's progressive dilutions, these investigators sought to determine how much mercaptan and how much chlorophenol must be introduced into the whole mass of air in a laboratory of a certain size in order to give an odor just noticeable to a person entering the room. The walls of the laboratory were perfectly smooth, the floor was of stone, and the equal distribution of the odorous gas to all parts of the room was secured by the motion of fans. The solutions were scattered with a fine spray.⁴ Unfortunately, these solutions were alcoholic.

In the same year H. C. Dibbits arrived at a partial determination of the stimulus-limen for the odor of acetic acid. Acetate of zinc is decomposed in the presence of water, and an insoluble basic salt and free acetic acid are formed. Dibbits, during the course of sixteen hours, allowed 60 litres of damp air to pass over a mass of salt which had been freed from water of crystallization, found the loss of weight to be 16.8 mg., and calculated the proportion that the weight of the acetic acid set free must bear to this loss of weight to be $\frac{1}{4}$. As 24 mg. of acetic acid must have been communicated to 60 l. of air, and as the odor was discernible in this air, the stimulus-limen of acetic acid must lie under 0.4 mg. per litre.⁵ While the methods of Fischer and Penzoldt and of Dibbits are comparatively accurate, it is obvious that they are impracticable for difference-determinations.

A method employed in 1889 by Ottolenghi for testing the olfactory sensitivity of criminals is a modified form of Valentin's, and is essentially the same as the method recommended by Passy in 1892.

¹ P. 80.

² Valentin: *Grundriss der Physiologie*, p. 515.

³ Zwaardemaker: *op. cit.*, p. 79.

⁴ *American Journal of Psychology*, I, p. 357.

⁵ Zwaardemaker: *op. cit.*, p. 84.

Ottolenghi used 12 aqueous solutions of essence of cloves contained in similar bottles in similar quantities. The solutions were graduated from 1:50000 to 1:100. The subject began with the weakest solution and took the bottles successively until sensation commenced. Passy dissolved a certain weight of odorous material in a given weight of alcohol, mingled a certain fraction of the solution with a given weight of pure alcohol, and so on, until he had obtained a graduated series of saturations. He then put single drops of his solutions into bottles of the same size, and arrived by the method of just noticeable stimuli at an estimate of the stimulus-limen in terms of saturation-strength and the area of his bottles.¹ Ottolenghi's combinations of essence of cloves and water were not true solutions. Passy's results are vitiated by the compensating effect of the odor of the alcohol. Both methods involve an error due to the constant loss of odorous material by the mere opening of the vessels for the subject to smell their contents, by inhalation, and by condensation on the walls of the vessels. Zwaardemaker suggests that fairly satisfactory results might be obtained on Ottolenghi's principle if one (1) employed only solutions in distilled water, (2) made very short inspirations, (3) used very large inhaling vessels, and (4) avoided all odorous substances the vapor of which is easily condensed.² Theoretically, if the series of saturations could be minutely enough graduated, this method might be employed for difference-determinations, but practically, the use of many large inhaling-vessels would make it too clumsy.

The first indirect method was invented by Frölich in 1851, three years after Valentin invented his direct method. Frölich gauged the keenness of smell by the distances at which odorous substances could be sensed under uniform conditions. He put up in tightly corked test-tubes such substances as ethereal oils, resins, spices, and musk mixed with starch in such proportions that however different in quality, the odors might be the same in intensity. The subject closed his eyes, the tube was uncorked and moved toward him, and both the distance at which the substance was first sensed and the time at which judgment was passed were marked.³ Frölich seems, however, to have made little use of his time-estimates. As the odors with which he worked are slowly diffused, the mass of odorous vapor may be thought of as moving with the tube. Yet results based on such a rough hypothesis cannot be very reliable.⁴ Moreover, the assumption that odors so unlike in quality are of the same intensity, since they can be just sensed by the same person at the same distance, begs the question of the value of the hypothesis mentioned, and Frölich seems to have had no other means of determining their comparative intensity except guess-work.

Aronsohn's famous method, devised in 1886, though indirect upon the ordinary theory of smell which makes the odorous particles act in gaseous form on the olfactory membrane, must be classed on Aronsohn's own premises as direct. His hypothesis is that odorous particles are in solution when they act on the nerve-endings. This assumption, for which J. Müller is chiefly responsible,⁵ is based (1) on the fact that fishes and amphibia have peripheral and central organs similar to the organs of smell in birds and mammals, and (2) on the fact that the nasal membranes are normally covered with mucus,

¹ Pp. 98-99.

² P. 99.

³ Pp. 80-81.

⁴ P. 81.

⁵ P. 62.

and that the drying of this mucus, as in the first stage of rhinitis, impairs the sense of smell. Tortuall and Weber had indeed proved that odorous liquids when introduced into the nose "do not smell," and Weber had also found that the sense is for a time impaired if warm or cold water or sugar and water are poured into the nasal cavities and retained there for a few moments.¹ Aronsohn explained these phenomena by supposing that strong solutions of odorous matter and liquids of foreign temperature if brought in contact with the delicate olfactory membrane must necessarily have a pernicious effect. He found, on the other hand, that very small quantities of odorous substances dissolved in normal saline solutions can be sensed if the mixture, at a temperature of about 40° C., is poured into the nose from the height of about half a meter. Weber had used cologne and water in the proportion of 1:11. Aronsohn used oil of cloves, for example, in salt and water in the proportion of 1:500. His olfactometric method consisted simply in determining how weak a solution of an odorous substance could be sensed if injected at the temperature proved empirically to be most favorable for its detection.² If Aronsohn's premises are correct, not only is his method direct, but the worst difficulties in the measurement of smell-stimuli are eliminated. In criticism of these premises, however, Zwaardemaker points out (1) that aquatic mammals have organs which resemble the organs of smell in land mammals, but are rudimentary, as if useless under water; (2) that the dryness of rhinitis is confined almost exclusively to the Schneiderian membrane and is conjoined with hyperaemia and swelling which obstructs the passage of air; (3) that the cilia of the olfactory cells protrude through the covering of mucus; and (4) that most odorous substances are not at all or are but very slightly soluble in water. Books on the perfume-industry are filled with the discussion of ethereal oils, of spices, gums, and the like. In a room saturated with perfume or tobacco smoke, a bit of cotton wool will take up the odor, while a glass of water will not. Moreover, as Zwaardemaker believes, it cannot be shown that Aronsohn succeeded in filling the cavity which contains the olfactory membrane so entirely with liquid that all bubbles of air were excluded. It is very difficult to drive all the air out of blind pouches.³

In 1893, Dr. N. Savelieff in the laboratory of Morokschowetz constructed an olfactometer on a principle entirely different from Zwaardemaker's. There were two flasks of glass, each with two corks. Through one cork in each, the two flasks were connected by a glass tube bent twice at right angles. Through the other cork of one was inserted a glass tube which reached to the bottom. Through this tube a mixture of ethereal oil and water was poured. The liquid did not reach the end of the connecting tube. Through the remaining cork of the second flask, which was filled only with air, was inserted a glass inhaling-tube which divided into a nose-piece for each nostril. The odor of the liquid was weakened by successive additions of water, and the intensity of the stimulus was measured through the proportion by weight which the ethereal oil bears to the water.⁴ As Zwaardemaker suggests the method of Savelieff has this great disadvantage, that its results do not stand in simple relations to the real stimulus-intensities. The intensity of the stimulus will vary according to the height of the liquid in the first vessel, and according to the ad-

¹ Weber: *Archiv f. Physiologie*, 1847, p. 351-354.

² Aronsohn: *op. cit.*, 1886, pp. 324-332.

³ *Op. cit.*, pp. 62-66.

⁴ *Neurologisches Centralblatt*, 1893, p. 343 sq.⁴

hesion of odorous material in different parts of the apparatus. Sav-
 elieff's method would indeed be fairly satisfactory for clinical pur-
 poses if real solutions were used instead of mixtures of ether, oil,
 and water. It is a great disadvantage, however, to begin an experi-
 ment by exhausting the sense-organ with a saturated solution.¹

*Section 2. Control in Zwaardemaker's Olfactometric Method of
 the Factors which Determine the Intensity of the Stimulus.*

Zwaardemaker's measurements of the smell-stimulus are in
 terms of but one factor of the genetic unit,—viz., in terms of
 the amount of odorous surface exposed. The time for which
 different extents of surface are exposed is supposed to be kept
 constant by the regularity of the movement of the hand which
 manipulates the odorous cylinder. All of these time-values
 are so small that their variation may well be disregarded.

In 1890, Henry, a French scientist, instituted in the interests of the
 perfume industry a modified form of Zwaardemaker's method, and
 took the time values into account. His instrument differs from
 Zwaardemaker's only in the substitution for the odorous cylinder of a
 porous paper cylinder, hollow, closed at the bottom, and saturated
 from a surrounding glass reservoir with the fumes of an odorous
 liquid. The glass inhaling-tube enters from the top, and the subject
 raises it with a uniform movement while he is making the inspiration
 required. Stimulus-intensity is reckoned in terms of the surface of
 the paper cylinder exposed, and of the time which the odorous vapor
 has had for diffusing into it since the lifting of the inhaling tube.²
 As for this second factor, by which alone Henry's method differs from
 Zwaardemaker's, Passy suggests that the time-rate of evaporation of
 a liquid under a membrane differs from the time-rate of the same fluid
 in the open air. Henry supposes that the pressure of vapor on the
 paper cylinder is constant, but on the contrary, since its surface is
 wholly covered at the beginning of the experiment and is gradually
 uncovered as the glass tube is raised, the pressure of vapor will con-
 stantly decrease.³ At any rate, Henry's apparatus will not answer for
 difference-determinations, as it would render procedure in both direc-
 tions impossible.

Much more serious in Zwaardemaker's method than any
 error which may arise from irregularity in the subject's move-
 ments is the error due to the adhesion of odorous particles in
 the glass inhaling-tube. These particles may condense on the
 sides of the tube or, if the substance is soluble in water, may
 dissolve in the moisture which forms on the inside during in-
 spiration. A correction can be made for adhesion only for the
 "minimum perceptible," and only for a determination taken
 with the perfectly dry and clean inhaling-tube and a saturated
 porcelain cylinder. It may be made as follows: Let the
 length of the inhaling-tube ordinarily used be x and let a be
 the value of the stimulus-limen as found with it. Then let a

¹ *Op. cit.*, pp. 100-101.

² *Comptes rendus de l'Academie des Sciences*, Feb. 9, 1891.

³ Zwaardemaker: *op. cit.*, p. 94.

shorter inhaling-tube of the same diameter and the length y be pushed for about 2 mm. into the odorous cylinder. Through the other end of this cylinder, which is usually the movable part of the instrument, let a third tube of the same diameter be pushed. By moving this third tube backward and forward, the extent of odorous surface exposed to the air is varied. Let the stimulus-limen found under these conditions be b . Then $a - b$ will be the difference in the stimulus-limen made by the adhesion of odorous particles to a tube of the length $x - y$. The correction to be made for adhesion to a tube of the length x will be as much greater as x is greater than $x - y$. If cylinders of solid odorous substances be used, this correction cannot be made, even for the stimulus-limen, since it is so exceedingly small. It is impossible, moreover, to take many determinations even of the stimulus-limen in an hour with a perfectly dry and clean tube. As for the difference-limen, it is both theoretically and practically impossible to make the adhesion-correction, for to know how much greater for sensation a given stimulus is than the liminal stimulus, one would have to know beforehand that Weber's law applied to that particular olfactory quality, and what the exact value of Δr for the quality

was. The effect of adhesion, in the first inspiration or at least in the very first few inspirations, is to decrease the strength of the stimulus, but after the first or at most after the second or third inspiration, the effect is rather to increase the strength of the stimulus, since the odor from the matter adhering to the inhaling-tube more than compensates for the loss of the odor of the matter which continues to adhere.

The tube must be carefully dried after it has been washed, and the subject must be trained not to breathe back into it. Yet on a damp day, the moisture left on the inside of the tube by the inspired air is no inconsiderable source of error. Bunsen computes the possible thickness of such a layer at '0.00101 mm. If a glass tube is 15 cm. long and 5 mm. wide, the area of its bore will be 23.57 qmm. This would make the weight of a layer of moisture of the thickness given by Bunsen 2.38 mg. If the odorous substance is in aqueous solution, this moisture may be left out of account, but if no moisture comes from the cylinder itself, it may vitiate the results of the experiment. Since the dampness of the air varies from day to day, this error cannot well be corrected.¹ All that one can do is faithfully to take the barometer-readings in the hope of finding in them possible explanations of erratic judgments. The experimenter must be careful to cool the inhaling-tube after dry-

¹ Pp. 124-125.

ing it over the spirit-flame, not only on account of the risk of distracting the subject's attention with a warm tube, but on account of the danger of heating the inside of the odorous cylinder.

Since the source of the odorous vapor is connected with the subject's nose by a tube of known length, the diffusion of the matter is, outside of the body, obviously under complete control.

The subject's breathing is, indeed, a seriously variable element, but its variation is by no means the greatest practical drawback to the method. Sniffing must, of course, be watched for and peremptorily forbidden. The mere expansion of the nostrils does not increase the intensity of the odor as it does under ordinary circumstances, but rather decreases it, since the field of smell is artificially limited, and the widening of the entrance to the nose simply increases the amount of air which dilutes the odorous gas. Under ordinary circumstances, as we have seen, the more rapidly one breathes, the stronger the odor one will get. If one uses the olfactometer, this is not true. Since the diffusion-rate within the cylinder is constant, increased rapidity of breathing will increase the degree in which the odorous particles are diluted with air on their entrance to the nasal passages. Thus, the more slowly one breathes, within a certain limit, the stronger the smell one will get. The air must be drawn in with enough force to carry part of the current above the lower turbinal bone. If the air simply takes the straight path to the choana along the floor of the nasal cavity under the lower turbinal bone, there will be no smell. Zwaardemaker believes that each subject with a little practice will discover for himself the best rate of breathing for obtaining the strongest smell from a given stimulus, so that, in a manner, the breathing rate will be self-regulating.¹ Our own experimental results seem to bear out this conclusion. In Section 1 of Chapter III, each subject's mode of breathing is noted, but its peculiarities can scarcely be traced in the numerical results. The inability of most of the subjects to arrive at difference-determinations with one inspiration must, of course, have aggravated the adhesion-error. Henry regulates the breathing of his subjects by putting about the chest a belt which allows only a certain expansion. Such an appliance must, however, have the effect of distracting the subject's attention and making the breathing unnatural. Following Zwaardemaker's example, we did not even stop the nostril not in use. The inhaling-tube was thrust into the forward² half of the nostril to the depth of half a centimetre.

¹ Pp. 86-87.

² A substance pressed against the back of the nostril can hardly be smelled at all, as its vapor will take the direct path to the choana.

We may say, then, that the most unsatisfactory features of Zwaardemaker's method are (1) the adhesion-error, and (2) a tendency which the subject, if he manipulates the odorous cylinder, has toward judging in terms of hand-movement. This difficulty will be discussed in another place.

While the intensity of the stimulus depends in the case of any sense upon the condition of the peripheral organ, no sense-organ is so likely to vary either through obstruction or through exhaustion as is the organ of smell. Let us now consider the variations from the normal condition to which this organ is most subject.

Section 3. Anosmia and Hyperosmia.¹

Whether pathological or non-pathological in origin, anosmia is of three sorts,—respiratory, essential or toxic, and nervous. Respiratory anosmia is due to obstruction of the nasal passages, from asymmetry of the nasal skeleton, from hyperaemia of the respiratory or Schneiderian membrane, or from accumulation of mucus. Toxic anosmia may be due to poisons in the inspired air,—a form not yet investigated,—to injurious fluids introduced directly into the chamber containing the sense-epithelium (as in Aronsohn's experiments), to poisons, such as morphine, pulverized and blown into the nose, or to certain forms of blood-poisoning, such as chronic nicotine-poisoning. The anosmia of smokers cannot be wholly attributed to their catarrh, though a light, acute nicotine-poisoning does not seem to produce a loss of smell. Nervous anosmia may be congenital,—*i. e.*, due to imperfect development of the olfactory vesicle in the brain,—or may be senile,—due to degeneration of some of the nervous elements which condition the sense,—or may be due to exhaustion of the olfactory nerve, or to dryness of the epithelium. If we rule out exhaustion, we may say that respiratory anosmia is vastly more common than toxic or nervous. The more peripheral parts of every sense-organ are more subject to injury and disease. Thus, the muscles and lenses of the eye give much more trouble than the retina and the optic nerve. In the case of smell, the sensory epithelium is well protected by its secluded position.

As to hyperaemia of the respiratory mucous membrane, its blood supply is controlled much more by the exigencies of breathing than by those of smell. It is largely under the sway of local reflexes. The fibers of the trigeminus which ramify through it are closely connected with fibers of the sympathetic nervous system. Too profuse secretion of mucus is the most common mechanical hindrance to smell. On the other hand,

¹ Pp. 136-165.

too small a secretion has a disastrous effect on the sense-epithelium. It seems that the tiny hairs of the rod-cells refuse to do their work if they become dry. The action of all the mucous glands of the nose may be increased by injecting strychnine, and decreased by injecting atropin into the membranes. Too much atropin, however, produces irritation and a flow of tears.

Hyperosmia may also be respiratory,—due to certain asymmetries of the skeleton or to anæmia of the respiratory membrane,—or toxic, or nervous. In hysterical subjects, hyperosmia is common. Anæmia of the respiratory membrane may be produced by smelling such substances as cocoa-butter, or cedar-wood, which rather powerfully affect the trigeminus.

The two forms of anosmia, which vary in the same subject from day to day, are respiratory anosmia from obstruction of the nasal passages by mucus, and nervous anosmia from exhaustion. It is possible at any time easily to discover whether the nasal passages are obstructed or not. The test can be made by exhaling on a concave metal mirror held at the level of the mouth. The clouds of condensed vapor give the true shape of transverse sections of the breathing-cones. They are divided from each other, and if the nasal passages are in a normal condition, they are symmetrical, and broader than they are long. As they pass away, they should each divide into an antero-medial and a postero-lateral division of about the same size. As divided, the spots should still be roughly symmetrical. The division is due to the projection of the "triangular cartilage" and the lower turbinal bone from the side wall of the nose. This division of the air current occurs in all mammals.¹ Pathological alterations in the mucous membrane of the nose and asymmetry of the nasal skeleton may alter the size and shape of these divisions, but rarely prevent them from appearing. The antero-medial division alone represents the current of air which passes above the lower turbinal bone. The form and position of the field of smell in an ordinary inspiration, therefore, corresponds roughly with this division, and would do so exactly if it were not for the slight difference in the course of the currents of inspired and expired air.²

The influence of exhaustion is more insidious. It varies from subject to subject, from substance to substance, and from one intensity of a substance and one general condition of a subject to another, so that numerical corrections are out of the question. Fortunately or unfortunately, the effects of adhesion and exhaustion are for the most part opposite. This

¹ P. 73.

² Pp. 73-74.

opposite influence makes one's numerical results more nearly correct than they would otherwise be. On the other hand, it makes the exact influence of each source of error more difficult to read from the figures. Yet it is not particularly difficult to detect the effect of the exhaustion when it is at all marked, and to exclude the most unreliable determinations. In our experience of thirteen different subjects, complete or marked anosmia from exhaustion, if it occurred at all, usually came on very suddenly.

Section 4. Psychophysical Methods Employed.

Before difference-determinations were made at all, the stimulus-limen was usually found as accurately as possible for the substance and subject concerned. The subject, starting with the end of the odorous cylinder even with the end of the inhaling-tube, moved the cylinder outward until he obtained a smell. If this smell seemed to him more than liminal, he moved the cylinder back for a short distance, and continued to move backwards and forwards until he had satisfied himself as to the point at which he obtained a just noticeable sensation. The method of moving steadily in both directions,—from a point considerably below to a point just above the limen, and from a point considerably above to a point just below the limen,—was tried, but was abandoned. It is often impossible, on account of adhesion in the tube or in the nasal passages, or on account of memory after-images, or cumulative stimulation, to move from a point of intensive stimulation to a point at which sensation entirely disappears. Memory after-images certainly occur. The existence of true after-images of peripheral origin has not been proved in the case of smell.¹

The only difference-determinations for smell, so far on record, are a few which Zwaardemaker performed for yellow wax and vulcanized rubber. The method which he employed, and the method which so far seems practicable, is Fechner's rough and simple method of just noticeable differences. One gives the subject a standard stimulus, and then after an interval, which one makes as nearly uniform as possible, a second stimulus which is appreciably greater or smaller. He himself then moves the cylinder until he makes the stimulus just greater or just smaller than the standard. When in the neighborhood of the stimulus, he moves back and forth as he likes, until he has satisfied himself of the accuracy of the determination. Thus, as there is near the limen procedure in both directions, the method may be classed as a gradation-method. The interval between the two stimuli averaged in our experiments $2\frac{1}{2}$

¹ P. 260.

seconds with the standard olfactometer, and 5 seconds with the fluid-mantle olfactometer. With the small olfactometer, it was never less than 2, and almost never greater than 4 seconds. It was ordinarily 2. With the large olfactometer, it varied from 4 to 6 seconds. The difficulty in manipulating the large olfactometer more quickly will be described in another place. The interval between determinations was much more variable. It was usually about a minute, except when the tube was cleaned. Our determinations were broken into short series in which Δ_{ro} and Δ_{ru} were found alternately. The series were divided from each other by the necessary cleanings of the inhaling-tube. With some substances, we washed and dried the tube after every 8 determinations, wiping it out with dry absorbent cotton in the middle of the series. With other substances, we washed and dried it at the end of every 4 determinations. It took about a minute to give the tube a dry wipe, making the interval between half series about 2 minutes. After practice, it took about 3 minutes to wash, wipe and dry the tube, making the interval between series about 4 minutes. These time estimates are all rough. We were not intent on time-determinations; the subject had often incidental remarks to make on his own experiences; and there were various untoward accidents,—water spilled, tubes broken, wire dropped, etc. The subject used his two nostrils alternately; all our records were kept for the two nostrils of each subject as for two different persons. We changed the order of determinations in successive series that exhaustion and adhesion might equally affect Δ_{ro} and Δ_{ru} for the right nostril and for the left. For example, 4 series might run thus:

- (1) Δ_{ro} f. R. N., Δ_{ro} f. L. N., Δ_{ru} f. R. N., Δ_{ru} f. L. N.
- (2) Δ_{ru} f. L. N., Δ_{ru} f. R. N., Δ_{ro} f. L. N., Δ_{ro} f. R. N.
- (3) Δ_{ru} f. R. N., Δ_{ru} f. L. N., Δ_{ro} f. R. N., Δ_{ro} f. L. N.
- (4) Δ_{ro} f. L. N., Δ_{ro} f. R. N., Δ_{ru} f. L. N., Δ_{ru} f. R. N.

With the standard olfactometer, after some practice in cleaning the tube, we took usually 32 determinations in an hour; with the fluid-mantle olfactometer, 24. It was not worth while to take more even if there was time, as the effect of exhaustion became too marked. Fortunately, the odors of the solids used with the small and easily handled olfactometer, were less exhausting than the insistent smells of most of the solutions.

With an unpracticed subject, we used one standard a day. With a practiced subject, we took determinations first with a weaker, then with a stronger standard on the same day. If the substance was very exhausting, we worked first with a weaker, then with a stronger, then with a weaker, then with a

stronger standard. The subject was always warned of a change in the standard.

Two grounds of objection to the method of just noticeable differences are mentioned by Wundt. They are the haphazard choice of the more intensive stimulus, which may light upon a stimulus unnecessarily large, and thus weary the subject's attention and sense-organ unnecessarily, and the irregularity and immeasurability of the moving back and forth in the vicinity of the difference-limen,—the "*Tatonnieren*." It should be noted, however, that as exhaustion increases during the act of determination, Δro would always be too large and Δru too small, were it not that adhesion has a precisely opposite effect, which is increased by the time-error. Thus, there is really a rude double cancelling of errors.

The true method of minimal changes involves great practical difficulties if applied to difference-determinations with Zwaardemaker's olfactometer. On account of the adhesion in the inhaling-tube, either two olfactometers must be used, and both inhaling-tubes cleaned after every comparison of two stimuli, or only such substances must be used as are insoluble in water and do not condense on the inner surface of the inhaling-tube. Zwaardemaker tried the method with vulcanized India-rubber, and believes it to be practicable for this substance.¹ We, too, tried it with the tube of red vulcanized India-rubber sent from Holland, and obtained very satisfactory results. (See Table VIII.)

We also tried a combination of the two methods mentioned. Giving the subject a variable stimulus objectively equal to the standard, we bade him make it subjectively equal,—for it would tend to seem subjectively less from the effect of exhaustion,—and then after pausing to let us take the reading, to make it subjectively just greater than the standard. Then he was directed to make a variable stimulus very appreciably greater, just equal subjectively. Next, after making an objectively equal stimulus subjectively equal, he made it subjectively less. Lastly, he made an appreciably weaker stimulus subjectively equal to the standard. Some of the results obtained by this method are given in Table VII. They are arranged in connection with results obtained for the same subject, substance and standard by the method of just noticeable differences. The uncertainty of a method in which the subject exhausts an already wearied organ by hunting for subjective equality before proceeding to the determination proper, is obvious. Therefore, the two sets of results tally surprisingly well.

¹ Pp. 189-190.

With any form of the method of just noticeable differences in which the subject himself alters the stimulus of comparison, there is liability to serious error from the subject's inclination to judge in terms of movement. When he has found that a certain hand-movement has made the stimulus of comparison just noticeably greater or less than the standard, he will expect the same movement to make it just noticeably greater or less again. He will be all the more tempted to judge in terms of hand-movement from the fact that he has been all his life forming estimates of space in terms of the sensations produced by movement, and has probably never thought of taking pains to compare the intensity of two odors. This tendency varies much in different subjects. Its presence may be suspected when the mean variation of a series is very small. Fortunately, it acts in such a way as rather to conceal the operation of Weber's law, if applicable, than to make it appear applicable if it were not. If, for example, one finds Δr to be 5 mm. for a standard of 20 mm., and by repeating the series of movements, obtains the same value of Δr for a standard of 40 mm., $\frac{\Delta r}{r}$ will

be $\frac{1}{4}$ in the one case, and $\frac{1}{8}$ in the other.

As a matter of fact our results offer evidence for the law which is strong to an almost suspicious degree. Yet it is not probable that a trained subject would, or that an untrained subject could deliberately alter his movements, when the standard was varied, so as to keep the value of $\frac{\Delta r}{r}$ approximately the

same, and it is absolutely impossible that twelve subjects out of thirteen should all do so. Such a procedure would argue a miraculous combination of psychophysical knowledge, accurate memory, industry and malice.

We also made some attempt to test the applicability of the method of right and wrong cases. At the time we tried it, which was early in the course of our experiments, we found it utterly impracticable. The fact that more than half the mistakes were made in thinking the second stimulus weaker than the first or equal to it, would indicate that exhaustion was the disturbing factor. Since, however, the subject seems genuinely to recognize the stimulus of comparison in the gradation-methods as greater or less than the standard, it is probable that the difficulty with the method of right and wrong cases is largely the utter confusion it produces in his mind. Most persons are not used to smelling attentively and have to "learn" a given smell-intensity.

CHAPTER II. APPARATUS AND MATERIALS.

Section 1. The Standard and Fluid-Mantle Olfactometers.

In our experiments, we employed the single "standard" olfactometer and a double form of the "fluid-mantle" olfactometer. Both instruments were supplied from Utrecht. The sliding tubes used with the standard or small olfactometer were formed of the odorous material itself, and covered with an outer tube of glass. Porcelain cylinders, saturated with odorous solutions, and fitted into larger glass tubes, have been largely used by Zwaardemaker in connection with this simple instrument. We, however, used the porcelain cylinders only with the large or fluid-mantle olfactometer. We shall reserve the consideration of the preparation of the odorous substances to the next section. Here we shall describe the screen and inhaling-tube of the small instrument, and all the appurtenances of the large instrument, except the odorous solutions.

1. Standard Olfactometer. The glass inhaling-tube has a total length of 15 cm. and a bore of 5 mm. The glass varies in different tubes from 1 to 1½ mm. in thickness. The portion which curves upward to fit into the nostril is never more than 1¼ cm. long. Zwaardemaker says that the angle of the bend seems to make no difference with the results of the experiment. He himself makes it a right angle, but Reuter makes it an angle of 40 degrees.¹ A metal sleeve carrying a raised bead at the edge towards the bent end of the tube and buttoning into a metal ring in the center of the small wooden screen is fastened to the tube in such a position as to allow 10 cm. to project beyond the screen. This portion is graduated into twenty divisions of 5 mm. each. The securing of the metal to the tube is a serious problem in practice. We were able to find neither odorless glue nor cement which would withstand the constant washing of the tube, and the drying over the spirit-flame, a performance which must be repeated from four to a dozen times in a single hour. We finally solved the difficulty for ourselves by pasting with freshly dissolved gum arabic a strip of paper to the tube, and working the metal ring down over it, where it fitted so tightly as not to be removed without a process of soaking. The graduated tubes can be easily duplicated by any glassware firm.² They are so frequently broken in cleaning by an unpracticed operator, that no extended course of experiments should be undertaken without laying in a stock of them.

The screen is a square bit of cherry wood,—7½ cm. broad by 10 cm. high by 1 cm. thick,—furnished with a handle and coated with varnish which is supposed to be odorless. The screen must, however, be freely exposed to the air, and when new, must be well sunned, or it will have a decided smell of its own. Its double purpose is to serve as a handle, and to protect the nostril not in use from the odor of the sliding cylinder. The subject in making his determination holds the handle of the screen in his left hand and moves the cylinder with his right.³

¹ P. 104.

² Messrs. Eimer and Amend, of New York, courteously duplicated for us all of our imported tubes.

³ The standard olfactometer can be made in any laboratory. See the

II. Fluid-Mantle Olfactometer. In this instrument, the constant saturation of the hollow porcelain cylinder is secured in the following manner: A section of wide glass tubing is secured between two circular and cork-lined end-plates of metal. One of the metal plates,—that which when the instrument is adjusted is nearer to the subject,—is furnished with three equidistant rods, inside of which the disks of cork and the glass tube fit. The three rods terminate in three screws with detachable heads. The screws pass through holes in the other metal plate. The plates are bored at the center to circular openings, 8 mm. in diameter, which coincide with the bore of the enclosed porcelain cylinder. The cylinder itself, which has exactly the length of the glass tube,—10 cm.,—is held in place simply by the pressure of the end-plates. The glass inhaling-tube passes through the screen into the bore of the cylinder. The odorous solution is put into the space between the cylinder and the glass tube with a pipette through one of two holes, 2 mm. in diameter, which are left one in each of the two metal plates, and closed with cork-lined screw-heads. It would be better if there were two of these holes in each plate, for it is extremely difficult to force a sluggish liquid, such as glycerine, against the pressure of the air into the space around the cylinder. If the rubber of the pipette is flaccid, it becomes almost impossible.

The "shells" thus constructed for mantling the cylinder with liquid, are mounted in a horizontal position on a wooden table,—27.7 cm. long by 16.4 cm. wide,—which can be adjusted to the required height above a heavily leaded base. Each of the shells can be moved to and from the observer along a way of hard wood. The rack and pinion movement is governed by milled heads,—diameter $2\frac{1}{4}$ cm.,—projecting from the table to right and left within easy grasp of the subject's hand. A scale and pointer enable the observer to determine how far the cylinder is moved.

The inhaling-tubes are made with the same bore and of glass of the same thickness as the graduated tubes used with the standard olfactometer. Those sent from Holland turn, one to the right and the other to the left before curving upward to be inserted in the nose. The metal sleeves, within which the tubes are cemented, do not bolt into the holes in the screen, but flare off each on its outer side into flat fan-shaped pieces of metal, which are screwed to tally with a mark on the screen. We made no experiments with these tubes, but used instead tubes of the same bore and thickness of glass, either with a somewhat shorter upright, or with but one curve. The tubes with one curve are precisely like the inhaling-tubes of the standard olfactometer, except that the part which extends through the screen is longer and is not graduated. It is a mistake to use two-jointed tubes at all, unless both nostrils are to be used, as in compensation-experiments. The extra curve seems to make no difference in the results, but it makes the tubes much harder to clean. The total length of our two-jointed tubes was $18\frac{1}{2}$ cm., and that of our one-jointed tubes, $17\frac{1}{2}$ cm. 11.3 cm. of every tube used must project beyond the screen. We fitted our tubes into hollow plugs of cherry wood turned to order in the shape of corks, so as to pass easily into the holes of the screen, and

directions given in Sanford: *Experimental Psychology*, p. 371. Scripture's blotting-paper olfactometer as, made by Willyoung, is rendered useless by the vulcanized India-rubber of the inhaling-tubes. We substituted for the inner glass-tube, rubber-tube, and nose-piece, a glass tube bent at right angles and expanded into a nose-piece at its upper end. The dimensions of this tube, however, make it very breakable, and it is quite impossible to clean it except by blowing through it.

to fit tightly when pushed home. To keep the tubes themselves from slipping backwards and forwards in the plugs, we gummed strips of paper to the glass at the edge of the wood. Lumps of these strips will continue to adhere even after many washings. These home-made substitutes for the heavy metal attachments are very serviceable.

We should advise all who purchase the instrument to strengthen the table with metal cross pieces on its under side. The upward warping, which is inevitable, narrows the ways and throws the inhaling-tube out of alignment with the porcelain cylinder. The result is a stiff movement of the rack and pinion on the one hand, and a perpetual breaking of inhaling-tubes on the other. Moreover, if the warping has gone far, the whole table is liable to split. We have also found it necessary to shave the edges of the wooden blocks which carry the shells, and to reduce the friction caused by two spring-brakes placed alongside of the ways. It would be much better if the carrying blocks were moved with cranks, rather than by the milled heads. The exertion necessary to turn the screw and the chafing of the hand by the milling are distracting to the subject's attention. Moreover, the intervals when the experimenter is turning the head to give the stimulus of comparison are undesirably long. Great care must be used in the selection of any oil which is applied to the instrument. We once used clock oil, and afterwards had extreme trouble in eradicating the odor.

The porcelain cylinders for these olfactometers are made by Hooft and Labouchere in Delft, and composed of pure kaolin. They must be kept continually immersed in water, and this must be removed at least daily to minimize the odor of the clay. They must not be dried before they are introduced into their glass coverings. The ends are perfectly smooth, and are glazed for use with the standard olfactometer. The outer and inner surfaces remain porous. All the cylinders used, whether made of porcelain or of the fragrant material itself, have a length of 10 cm., and a bore of 8 mm., so as to slide easily along the inhaling-tube, and to cover, in case of the standard olfactometer, the graduated portion of the tube lying beyond the screen. The external diameter,—counting the thickness of the protecting shell of glass, when present,—varies from 14 to 16 mm.

Section 2. Preparation of Odorous Materials.

In Table VI (Chapter III, Section 2) the odorous materials are arranged in their order according to Zwaardemaker's scheme of olfactory qualities. We shall here describe them in groups according to their mode of preparation. We shall consider first the preparation of the tubes of solid odorous matter, and afterwards discuss the solutions used to saturate the porcelain cylinders.

1. Preparation of Odorous Substances Used in Solid Form. The solid odorous materials from which tubes or hollow cylinders were prepared were vulcanized India rubber, black, red, and gray; cedar, rose-wood and musk-root; Russian leather, yellow wax, paraffine, glycerine soap, mutton-tallow, cocoa-butter and solid oil of mace, asafoetida, gum benzoin, tolu balsam, and a combination of gutta-percha and gum ammoniac in equal parts by weight. Tubes of red and black India rubber, and of gutta-percha and gum ammoniac came with the standard olfactometer from Utrecht. All the other cylinders, and a second tube of gutta-percha and gum ammoniac, were home-made. It is necessary that all such cylinders should be fitted into glass tubes

of the same length in order that no odor from their outer surfaces may pass around the screen.

India rubber has three great qualifications for use in experiments in smell. (1) It can be smelled for a long time by most subjects without blunting the organ; (2) its odor is not easily obscured by other odors, and (3) adheres comparatively little to the inhaling-tube. Two of our subjects (*C.* and *Sh.*), however, complained more of smarting in the nose when using rubber than when using any other substance. The age and mode of preparation of different sorts of rubber, and the amounts of sulphur in them, make some difference in the quality and slight differences in the intensity of the smell. The intensity, is, on the other hand, virtually the same at all degrees of temperature between 13° and 30° C. The cylinder may be prepared by cutting 10 cm. from a rubber tube with a bore of 8 mm., and working it into a glass tube of the same length. The rubber must be clean and new, and, in particular, must never have come in contact with illuminating gas. Although the odor of the rubber when fresh is not easily disguised by other smells, yet the substance easily loses its own odor and takes that of other substances. An inhaling-tube or the broken fragment of one should, therefore, be left in the cylinder so as to cover its inner surface when not in use. Such tubes must never be allowed to lie about unprotected on the shelves of a wooden cupboard. If not sealed by containing the inhaling-tube, they should be rolled up in clean glazed paper and shut up in a jar by themselves.

Our cedar and rose-wood cylinders were turned to order. A block of wood $2\frac{1}{2} \times 2\frac{1}{2} \times 4\frac{1}{2}$ ins. will make four of these tubes. Each was held in its place in the outer tube of glass by a small bit of "instant crockery-mender" applied to the wood before putting it in. The fit is so tight that the odor of the paste cannot escape. These cylinders also are very liable to lose part of their odor, and should be carefully protected. Messrs. McKesson and Robbins, of New York, furnished a single piece of musk-root large enough to make two cylinders. One crumbled in the turning, but the other broke evenly around the circumference into two sections, which were pushed so tightly into a glass tube as to stay in place of themselves. The crack was almost invisible, and as it was 6 cm. from one end of the tube, it did not render the cylinder really defective. From the Russian leather,—which was genuine, and not the "Russian leather" of America, which is tanned with birch instead of sandal wood,—a piece 24 mm. wide and 10 cm. long was cut, and was fitted into a tube so as exactly to cover the inner surface. Cylinders may be prepared in the same way from India rubber sheeting.

The other substances were all melted and moulded. The glycerine soap was Pear's, the mutton fat employed was fresh from the butcher's, the cocoa-butter, paraffine (the kind used by histologists), gum benzoin and gum ammoniac were such as can be bought of any retail druggist. We obtained of McKesson and Robbins "solid" oil of mace and the pure juice of *asafoetida* done up in small tin cans, and also a quantity of gutta-percha in narrow fibrous sticks or slabs, and of tolu balsam entirely freed from impurities. For the outside mould, the permanent glass shell must, of course, be used. The glass tubing was cut beforehand in our case into lengths of 10 cm., and these moulds were corked at one end, so that the tube of odorous matter was never quite so long as its shell. For the inside mould, we used an inhaling-tube, or the long straight part of one which had broken at the curve. The tube may be kept upright by digging a hole for the end of it in the cork. This end should be plugged to prevent the liquid from working up into the tube, through which it is sometimes necessary to pour

warm or cold water. All the odorous substances in this group were melted in a water-bath. We crumbled or shaved them into a small beaker, which we floated by means of a ring of cork in a large beaker of water over a Bunsen burner. We tried to melt the gums in a sand-bath, but succeeded only in charring them. The mass which we obtained by melting the gum ammoniac and gutta-percha together was of lighter color than that sent from Holland, and was not entirely free from the fibres of the gutta-percha. It was spongy and easily moulded by the fingers into any desired shape. The soap, paraffine, cocoa-butter and tallow are readily manipulated. They solidify in a very few moments if the outer tube is immersed in cold water, and the removal of the inner mould presents no difficulty. Tubes of these materials were kept all the summer in a room of which the temperature occasionally rose to 94° F., and sustained no damage by the heat. The tubes of soap, however, sometimes shrivel in a few days independently of the temperature. The longer the paraffine is heated the stronger the odor. Zwaardemaker succeeds in giving it an odor as strong as that of tallow or musk-root. We did not try heating it longer than an hour and a half, and our paraffine tubes gave the weakest of all our scents. Tubes of tallow are easy to make and to keep, and do not exhaust the subject's sense-organ to any appreciable extent, and are therefore especially to be recommended.

The oil of mace has a consistency like that of table-butter. It melts rapidly, and solidifies almost instantly when the outer mould is plunged into ice water, but tends to stick to the inner tube, and to come out with it in perfect shape. To remove the inner tube by itself, we filled it with ice water, and then hastily poured a little hot water over the outer mould. When once made, the mace tubes should be kept in a cool place, and the jar in which they stand should not be set on end. While they are in use, they must be grasped only with the tips of the fingers, and must be cooled every few moments with ice or snow. The juice of *asafoetida*, when pure, never becomes solid enough to be moulded. We poured small quantities of it, when melted, upon a mass of pulverized carbonate of magnesia, and worked the two materials together with our fingers, as one works flour into a very soft dough. We put lumps of this mixture into an outer mould, heated it in the water bath for a few moments, and then forced the inner tube down through the mass as nearly parallel with the outer mould as possible. After many attempts, we succeeded in making several satisfactory cylinders. Their odor, in spite of the adulteration of the *asafoetida*, is only too strong.

The gums never become very liquid in melting, and they solidify almost instantly when removed from the heat. We found it difficult to pour the gum benzoin, and impossible to pour the tolu and the mixture of gutta-percha and gum ammoniac, into the space between the inner and outer moulds. We poured this mixture and the tolu into the outer tube when empty, and then forced the inner tube into its place, as in the case of the *asafoetida*. When the fragrant substance is a gum, this inner tube must be greased. We coated it rather thickly, but evenly, with lanoline, which is as nearly odorless as grease can easily be found, and which evaporates quickly. All these tubes of gum retain their odors well, but the tolu is likely to melt out of shape in a hot room.

Before these cylinders are used, the section of odorless substance exposed at the outer end must be covered. We employed a little ring or cap of glazed paper gummed to the surface. Even with this precaution, the odor of the *asafoetida*, mace, butter and Russian leather, is quite apparent when the instrument is closed by pushing the odorous tube

as far in as possible. It apparently proceeds from such space as there is between the inside surface and the inhaling-tube. The inhaling-tube, on the other hand, must not fit too closely in the inside of the odorous tube, for if it does, the subject will be able to move it only in irregular jerks, and it will, moreover, scrape off shavings from the inside surface of a cylinder of soft material, such as asafoetida or oil of mace. When it is used with the Russian leather, a bit of paper may be gummed around it to make it fit somewhat more closely. Even this, however, does not keep the smell of the leather from making itself apparent in the space from which one breathes through the tube. We attempted to find "negative stimulus-limina" for the troublesome substances, in the following manner: We used a graduated inhaling-tube 4 cm. longer than the ordinary one, and adjusting the cylinder over the 10 cm. nearest the screen, moved out to find the limen. The device was not successful. The odor still diffused itself through the space from which the air was drawn. All the determinations of difference-limina for these substances involve a constant error,—namely, the addition of an increment, which we have no means of measuring, to every stimulus represented on the tube.

II. Preparation of Odorous Substances in Solution. Of the odorous substances used in solution, the caryophylline, citral, vanilline, coumarine and heliotropine were among the "De Laire Specialties," and were, with the ethyl butyrate, tincture of musk, and oil of camphor, the gift of Messrs. Dodge and Olcott, of New York. "The De Laire products," writes a representative of Dodge and Olcott, "are not an embodiment of the simple chemical formulas suggested by their names. They are compounds after secret recipes, and their names denote only the odor or flavor or other quality which it is claimed they reproduce or imitate. De Laire's caryophylline, for example, is not the caryophylline of your chemical formulas, a distinctly isolated aromatic principle, but a preparation, having doubtless as its base one of the clove-oil products, which is intended to supply the perfumer with the bouquet of the clove-pink." We have retained the De Laire spelling of their own specialties. The chemical formulæ of butyric ether, valerianic acid, allyl sulphide, and pyridin are, respectively, $C_4H_8O_2$, $C_5H_{10}O_2$, $(C_3H_5)_2S$, and C_5H_5N . The butyric ether used was a commercial product, but the valerianic acid was obtained at the chemical laboratory of the University, and the allyl sulphide and pyridin, as well as the oil of anise, were had of the Theodore Metcalf Company, of Boston.

Our solvents, mixtures, and concentrations were as follows:

Oil of camphor in liquid paraffine, a mixture,	1:500
Caryophylline in pure glycerine, a true solution,	1:500
Oil of anise in liquid paraffine, a mixture,	1:166 $\frac{2}{3}$
Valerianic acid, in water, a true solution,	1:1500
Ethyl butyrate, " " "	1:1000
Citral, in liquid paraffine, " "	1:500
Vanilline, in pure glycerine, " "	1:125
Coumarine, in liquid paraffine, " "	1:1000
Heliotropine, in liquid paraffine, " "	1:125
Natural Musk, the ordinary alcoholic tincture, in water, a mixture,	1:125
Allyl Sulphide, in liquid paraffine, a true solution,	1:1000
Pyridin, in water, a true solution,	1:500
Laudanum, the ordinary alcoholic tincture, a true solution, unmixed.	

Some of the musk was of course precipitated by the addition of so much water, and floated about in dark brown specks, a state of affairs anything but desirable.

We are aware that all the concentrations are startlingly high. We could not, however, use lower concentrations if we were to fix our standard-stimulus in two places on the scale. With a few exceptions, our stimulus-limina were much higher than those given by Zwaardemaker as normal. These facts will be noted later in detail. Zwaardemaker recommended vanilline in glycerine in the concentration of 1:1000 and coumarine and allyl sulphide in paraffine in the same concentration as especially well fitted for difference-determinations. We did use the coumarine and allyl sulphide in these concentrations, but most of our subjects obtained no odor whatever from the vanilline at 1:1000, and in no case did the stimulus-limen fall for both nostrils below 36 mm.

For coumarine, heliotropine and tincture of musk, stimulus-limina were found in a satisfactory manner. With all the other substances, an odor was apparent when the pointer of the fluid-mantle olfactometer stood at zero. The odor, undoubtedly, came from the space between the inhaling-tube and the inside of the porcelain cylinder, as great pains had been taken to wash away every drop of liquid from the metal plates. It is almost impossible so to adjust the inhaling-tube that it will not scrape against the clay at some point, and to paste paper around it would be out of the question, since the paper would continually rub and wipe the odorous surface. The odor was apparent 4 cm. from the end of the ordinary inhaling-tube when the cylinder was supposed to be sealed. All the determinations of difference-limina for these substances also are, therefore, subject to a constant error, but not so great an error as occurs in the results for the troublesome solids with the exception of Russian leather. The odor of the solutions when the instrument was closed was usually barely liminal.

When water was used as a solvent, it was, of course, distilled. The measuring-glasses and the bottles used should be rinsed well with distilled water, or at least with water which has been freshly sterilized by boiling just before the liquids are poured into them. An aqueous solution becomes unfit for use if long exposed to the light. Zwaardemaker advises that the fluid-mantle of the porcelain cylinder be changed every two days. We usually not only changed the mantle, but made a fresh solution, as often as this. It is safe to use the same glycerine or paraffine solution for days or even some weeks. The glycerine is much more difficult to put into the receptacle than the paraffine, and for citral and caryophylline it is not so able a solvent. It is difficult, however, to obtain and keep liquid paraffine quite free from a slight odor, somewhat pungent and somewhat like that of vaseline. Alcoholic solutions are, of course, more or less undesirable, as we have noted before. If Δr were known to bet he

same for all qualities, there would be no objection to using such solutions, but to assume that it is, is to beg one question at issue. We could not manage the musk and the opium, however, in any other form.

Section 3. Other Arrangements and Appliances.

For cleaning the inhaling-tubes, one needs a funnel of which one end is small enough to fit into the bore; two small light vessels,—tin cups are best,—for pouring water back and forth through them; a roll of absorbent cotton; a piece of pliable brass wire; some listerine; and a small alcohol lamp. After a tube is washed, it must be wiped inside and out with absorbent cotton before it is dried more thoroughly over the spirit-flame, else it will break. We used listerine occasion-

ally as a deodorizer during a set of experiments, and always as a disinfectant at the end of the hour. Its own odor is easily washed away. As it takes some time for a porcelain cylinder to become thoroughly impregnated with an odorous solution, it is convenient to have test-tubes with tightly fitting corks, in which a number of cylinders may be put to soak at the same time. Unless they can be kept in a dark cupboard, it is well to wrap up these tubes in several plies of black calico. Bottles of yellow glass, such as perfumers recommend for the safe keeping of heliotropine, might well be used for all the solutions, but if they are not available, the ordinary bottles of colorless glass can be wrapped up in black cotton cloth. The less woolen cloth about the room, the better. We keep our solid cylinders in "self-sealing" preserve jars. When the cylinder with its fluid-mantle in place is not in use, the bore should be corked to keep the inner surface from drying off. It may, indeed, be filled with the solution and corked when it is put away for some time. In this case, all drops of liquid must be wiped out with absorbent cotton before the experiments begin. If it seems likely that much odorous substance has condensed on the inner surface, the whole bit of apparatus, glass shell and all, may be immersed in water. The bore should then be filled for a few hours with the odorous liquid.

The walls of the room in which our experiments were made are covered with oiled paper, and the floor is covered with oil-cloth which has a coating of shellac. The room has at present this defect, that when the wind blows in certain directions, it is impossible to create through it a draft of air which does not pass first through a hall frequented by students and therefore dusty, and by no means free from odor. When the standard olfactometer was used, the subject sat between the observer and the window, and at right angles to the observer, so that the light shone through the graduated inhaling-tube. When the fluid-mantle olfactometer was used, subject and observer sat at right angles to each other at the end of a low table.

CHAPTER III. RESULTS.

Section 1. The Several Subjects and their Stimulus-Limina.

Individual variations in the sense of smell are so great that it is necessary to preface a chapter on experimental results with an account of the subjects. The following notes upon our subjects in alphabetical order are thrown into "noun-form" for the sake of brevity.

Be. (Dr. I. M. Bentley), a *trained* subject.

Organ impaired by acute catarrhal troubles and easily exhausted.

Breathing spots always blurred and ragged at the division lines,—indicating a catarrhal condition of the membranes,—and never quite symmetrical.

$r\lambda$ usually determined with one *inspiration*; Δr determined with from 2 to 4 *inspirations*.

Movements of cylinder long and slow, but few.

Position indicative of strain.

Bi. (Miss E. M. Bickham), a wholly *untrained* subject. *General physical condition* neurasthenic.

Organ twice operated on (in '95 and '96) for hypertrophy of the

membranes. Superfluous portions removed from both sides. No catarrh now apparent.

Breathing spots usually well-rounded and symmetrical with neat division lines.

$r\lambda$ and Δr determined with but one *inspiration*.

Movements of cylinder rapid with little repetition.

Position indicative of strain.

C. (Miss M. H. Carter), a *partially trained* subject.

Organ very easily exhausted. Membranes subject to sudden congestions of blood and mucus upon nervous fatigue. Adenoid growth as a child. (The growth was not cut away, but disappeared of itself.)

Breathing spots ragged, ill-defined, and almost never symmetrical.

Breathing during an experiment irregular and violent. Tendency to sniff obstinate. $r\lambda$ and Δr usually determined with 1 or 2 *inspirations*.

Movements of cylinder rapid with little repetition.

Position indicative of much strain.

D. (Mr. S. J. Druskin), a *partially trained* subject.

Breathing spots perfect, as a rule.

$r\lambda$ and Δr usually determined with 1 or 2 *inspirations*.

Movements of cylinder at first rapid and few; after practice, tentative with noticeable repetition.

Position indicative of but slight strain.

K. (Mr. T. Kairiyama), a *trained* subject.

Organ much impaired by hay-fever and other catarrhal trouble.

Breathing spots fairly symmetrical as a rule, but ragged at the edges.

$r\lambda$ and Δr usually determined with 1 or 2 *inspirations*. Expiration violent ("to clean out the smell").

Movements of cylinder tentative but few.

Position indicative of but slight strain.

M. (Miss E. B. Macleod), a wholly *untrained* subject.

Breathing spots seldom quite symmetrical and never well defined. No catarrh before the current winter.

$r\lambda$ and Δr usually determined with 1 or 2 *inspirations*.

Movements of cylinder always irregular from want of practice.

Position easy.

N. (Mr. A. C. Nutt), a *partially trained* subject.

Organ: Easily exhausted. Sensitivity somewhat higher on the right side, as a rule. (The subject complained of "feeling left-handed" on the left side.)

Postero-lateral half of left *breathing-spot* usually missing (a fact showing chronic obstruction of the left inferior meatus). Both spots ill-defined.

$r\lambda$ and Δr determined usually with 2 or 3 *inspirations*.

Movements of cylinder slow and tentative with but little repetition.

Position indicative of strain.

P. (Mr. C. A. Perry), a *partially trained* subject.

Organ much impaired by chronic catarrh. Diseased portions removed from the lower turbinal bones on both sides.

Breathing spots rarely symmetrical. Secondary division quite apparent in spite of the operation mentioned. Spots ill-defined.

$r\lambda$ and Δr usually determined with one *inspiration*.

Movements of cylinder slow and tentative with but little repetition.
Position indicative of but slight strain.

Rob. (Mr. E. P. Robins), a *trained* subject.

Breathing spots rarely symmetrical or perfectly defined.

$r\lambda$ and Δr almost invariably determined with one *inspiration*.

Movements of cylinder slow and tentative with but little repetition.

Position indicative of but little strain.

Rog. (Miss L. R. Rogers), a *partially trained* subject.

Breathing spots rarely symmetrical or very well defined.

$r\lambda$ and Δr usually determined with 2 or 3 *inspirations*.

Movements of cylinder slow with much repetition.

Position indicative of but slight strain.

Se. (Mr. W. B. Secor), a *trained* subject.

Organ: Sensitivity somewhat higher on the right side as a rule.

Postero-lateral half of left *breathing spot* usually very small or missing as with *N*. Spots ill-defined.

$r\lambda$ and Δr usually determined with 2 or 3 *inspirations*, *movements of cylinder* slow with some repetition.

Position indicative of strain.

Sh. (Dr. Stella E. Sharp), a *trained* subject.

General physical condition neurasthenic.

Organ easily exhausted.

Right *breathing spot* usually larger than left, edges of both spots clearly cut.

$r\lambda$ and Δr usually determined with one *inspiration*, *movements of cylinder* slow with little repetition.

Position indicative of much strain.

T. (Dr. Ellen B. Talbot), a *trained* subject.

Organ somewhat easily exhausted. Portions of both lower turbinal bones removed to prevent congestions of mucous in the upper passages. Sensitivity somewhat higher on the left side.

Breathing spots well rounded and clearly cut. Secondary divisions imperfect. (When the nasal passages were clear the division was represented only by indentations at the edges of the spots.)

$r\lambda$ at first determined with one *inspiration*; later in the work, with 2, 3, or even 4 as a more satisfactory procedure. Δr usually determined with 2 or 3 *inspirations*.

Movements of cylinder very slow and cautious with much repetition.

Position indicative of but little strain.

In the notes just given a subject is called "trained" if he had had a fair amount of experience in general introspection. Only *Be.* had had any training in smell-experiments before the beginning of the course described in this paper. Some months earlier we had made a futile attempt to find his difference-limen with the weaker Utrecht cylinder of gutta-percha and gum ammoniac by the method of minimal changes. A subject is called "partially trained" if he began psychological laboratory-work about the time when these experiments commenced. The word "repetition" is used in connection with the manipulation of the cylinder to denote the moving backwards and forwards at the limen.

The breathing spots of all the subjects varied much from day to day. Sometimes they were broken up into several bands, always running rather from front to back than laterally. Often one narrow

medial strip would separate from one or the other. In most cases a more or less jagged and blurred outline showed the adhesion of clots of mucous to the passage-walls. In fact, twelve out of the thirteen subjects had suffered or were suffering from frequent "colds" or from hypersecretion more or less chronic. As a function of the turbinal bone is to deflect a part of the inspired air to the upper passages, its removal damages the sense of smell. The sensitivity of *T.* was higher on the left side of the nose, from which, as she reported, the smaller amount of bone had been taken, but the small remains of the secondary division of the breathing spots did not indicate that more bone had been removed on the one side than on the other. The obstruction of the inferior meatus would not, in itself, do much mischief to the sense, but it must indicate a dropping of mucous from the upper passages. It is of some interest to note that the subject (*D.*) whose spots are most perfect is a Russian. He came, however, to live in New York city at the age of twelve. *K.* is Japanese, but has been long enough in this country to suffer severely from the catarrhal climate. *Rob.*, one of the best subjects, comes from Prince Edward's Island. The homes of the other ten are scattered over the States from Eastern Massachusetts to California, though none are farther south than Missouri.¹

When it is said that Δr was determined with one, two, or more inspirations, it is meant that the stimulus of comparison was manipulated during one, two, or more inspirations. More than one inspiration was almost never taken to "learn" the standard. It seemed better to risk the increase of adhesion by allowing a subject to take as many breaths to a determination as he wished than to make him try to form a judgment when the force of an inhalation was decidedly on the wane. Many of the subjects considered a judgment with one inspiration an impracticable ideal. *D.*, *K.*, *Se.* and *Sh.*, and in a smaller measure *Be.* and *P.*, had a bad habit of suspending an inspiration, and not of sniffing, but of "holding the breath" momentarily during an inspiration. This practice must have tended to weaken the stimulus by allowing the air in the upper chamber to rush downwards to the middle meatus. *Be.*, *N.*, *P.*, *Rob.*, *Se.* and *T.* noticed that the stimulus was stronger during the latter part of an inspiration. This may point to cumulative stimulation of the rod-cells, or it may merely mean an access of attention and an unconscious sniff. *Se.*, who had the habit of suspending an inhalation, noticed the increase most after a strong inspiration, and *D.*, *K.* and *Sh.*, who had the same habit did not notice it at all. And it is clear that this peculiar mode of breathing would tend to prevent cumulative stimulation. On the other hand, *Be.*, *P.* and *T.* noticed the increase most when the stimulus was near its limen, and this looks as if it were a matter of attention and breathing-rate, especially as *T.* did not hold her breath. *Be.* remarked that the least difference of attention altered the stimulus. *Rob.* thought the first part of an inspiration gave the fairest measure of an intensity, and *Be.* and *Se.* relied on it "in easy judgments," but judged by the latter part of the inspiration if the stimulus were weak or vague. *N.* and *P.* asserted that they judged "by the impression as a whole," but *N.* confessed to a tendency "to emphasize the last whiff." *T.* reversed the procedure of *Be.* and *P.*, usually judging by "the last whiff," but repeating the inspiration and relying on the first impression if the determination were difficult. With *Rog.* exhaustion often supervened in a long inspiration. It is clear that if the intensity of

¹ Spraying the subject's nose at the beginning of the hour might be a useful expedient, but we did not try it.

a stimulus alters with the duration of an inspiration as well as with the manipulation of the instrument, the subject must make more than one inspiration to determine a limen, unless the judgment is very easy. It is probable that the first part of the inspiration, before the smell "blossoms out," gives the best criterion of the intensity of a stimulus. We would suggest that cumulative stimulation of smell would be a profitable subject of investigation.

In an effort to smell with the standard olfactometer, *C.*, *D.*, *K.*, *P.*, *Rob.*, *Rog.*, *Sh.* and *T.* all tipped the head to the left if using the left nostril, and to the right if using the right, pointed the outward end of the inhaling-tube in the same direction as the head was tipped, and slanted the screen in the opposite direction. This odd uniformity is perhaps explicable. On entering the nose the air ordinarily streams a little toward the septum and the opposite directions in which the subject slanted his head and the screen tended on each side to throw the opening of the nose-piece into an acute angle with the septum, while the turn given to the instrument in the horizontal plane threw the opening a little toward the front of the nose. On the other hand, *Se.* exactly reversed these directions on each side, and so did *Be.*, except that he turned the tube to point in the same direction as the screen was slanted, so throwing its inner opening towards the back of the nose. *Bi.* slanted both head and screen to the right when using the right nostril, and to the left when using the left. This was probably a mere matter of attention to one nostril or the other. She was not consistent in the pointing of the tube. *N.* turned everything to the right. Unfortunately, no written notes were taken of the hand used, but it was usually the right, the hand farther from the experimenter. All the subjects tended to tilt the hand forward and the screen backward,—probably in their desire to get "nearer" the stimulus. Almost all, unbidden, closed their eyes.

T. once mentioned verbal associations as an aid in memorizing the stimulus. This expedient was not common. *Be.* wrinkled his forehead and nose in a marked degree, and once noted a tendency to judge in terms of strain, especially about the eyes. Some substances were pungent to a disturbing extent to every one, but *C.* and *D.* complained much of "pain" from odors which no one else thought pungent. *D.* explicitly distinguished the sensation from pressure. He thought coumarine both pungent and "sour." Both *C.* and *D.* said that they received simply sensations of pressure from some stimuli. With *D.* sensations of smell merged in sensations of pressure as the organ became exhausted. *C.* said that when she tried to smell the black rubber with the left nostril she merely felt as if she were "breathing a feather," or as if the inside of her nose were "pressed with a soft wad." Yet the judgments made with this nostril agreed pretty well with those made with the other. *Be.* occasionally spoke of sensations of pressure or pain from the stimuli. Most of the subjects expressly denied temperature-associations. *Be.*, however, said that tolu and heliotropine were cold; *M.* that cocoa-butter was cold; *Rob.* that vanilline was cold; and *N.* that white tallow and musk-root were warm, and camphor cold, and that every smell grew warmer as it grew stronger. He thought of heliotrope as "warm, dark and deep," in contrast with ylang ylang, which was "light and fluffy."

The comparative sensitivity of the subjects may be judged from the following Table:

TABLE I. A TABLE OF STIMULUS-LIMINA.

Part I. Stimulus-Limina Arranged to Show Individual Variations.

SUBSTANCE.	Nostril.	Bo	Bl.	C.	D.	K.	M.	N.	P.	Rob.	Reg.	Sc.	Sh.	T.	L.
		M	Mm.	Mm.	Mm.	Mm.	Mm.	Mm.	Mm.	Mm.	Mm.	Mm.	Mm.	Mm.	Mm.
Black rubber,	R.	36		4	(22)	(43)	(35)	12		(61)	1	(12)	7	(38)	
	L.	34		5	(23)	(59)		11		(50)	1	(23)	10	(30)	
Gray rubber,	R.	9	(35)		1		(19)				(1)	5	(7)		
	L.	8	(29)		6		(22)				(1)	9	(10)		
Red rubber,	R.										(1)		(4)		7
	L.										(0)		(5)		
Russian leather,	R.	0				0								0	10
	L.	0				0								0	
Paraffine,	R.										12		(21)		10
	L.										20		(14)		
Rosewood,	R.					6		8	(54)			3			3
	L.					8		7	(67)			11			
Cedar,	R.			(4)				(27)	(10)				5	31	20
	L.			(5)				(29)	(12)				10	13	
Gum benzoin,	R.			7				(19)					(6)		10
	L.			8	7			(17)					(8)		
Gum ammoniac	(1) R.					(7)				(9)	(8)		(12)		
& gutta-percha:	(1) L.					(17)				(8)	(10)		(21)		
(1) First															
Utrecht cylinder,	(2) R.								(9)						
(2) Second															
Utrecht cylinder,	(2) L.								(8)						
(3) Home-made	(3) R.							9	2						
cylinder,	(3) L.							18	4						
Yellow wax,	R.														2.5
	L.														
Cocoa-butter,	R.	10	(16)				(7)		7						1
	L.	8	(17)				(4)		12						
Tolu balsam,	R.	14			4	1			(62)			1		9	1
	L.	19			3	1			(49)			6		5	
Musk-root,	R.							4				7			
	L.							8				5			
Mutton-tallow,	R.							4				2			
	L.							6				5			
Asafetida,	R.	0				0								0	
	L.	0				0								0	
Oil of Mace.	R.			0	0	0		0	0	0		0			
	L.			0	0	0		0	0	0		0			
Coumarine,	R.	17	(2)	(20)	(6)	(8)	(1)		(25)	(12)	(12)	(4)	(27)	(36)	
	L.	23	(2)		(6)	(12)	(3)		(21)	(11)	(10)	(5)	(54)	(33)	
Glycerine soap,	R.						(19)		(12)	(7)					2
	L.						(15)		(13)	(4)					
Heliotropine,	R.	24						(33)						(9)	
	L.	39						(33)						(10)	
Musk.	R.					(8)						(7)			
	L.					(2)						(7)			

TABLE I.—Continued.

Part 2. Stimulus-Limina Arranged to Show Variations Due to Practice and to Differences of Temperature.

SUBJECT.	SUBSTANCE.	NOSTRIL.	Value of $r\lambda$ in cm.	THERMOMETER READING.
Be.	Tolu balsam	R.	(32)	53°F
		L.	(35)	
		R.	14	60
		L.	19	
K.		R.	(24)	54
		L.	(28)	
		R.	(21)	52
		L.	(22)	
		R.	4	64
		L.	3	
	Rosewood	R.	(16)	59
		L.	(29)	
P.	Cocoa butter	R.	(13)	64
		L.	(22)	
		R.	6	62
		L.	8	
		R.	(27)	62
		L.	(26)	
		R.	(19)	62
		L.	(27)	
		R.	7	66
		L.	12	

All the values of $r\lambda$ given in this Table are averages of several determinations taken on the same day. Those enclosed in parentheses were found when the subjects had had little or no experience with the substances in question. Those not so enclosed were found after the respective substances had been used by the several subjects in difference determinations. In the first part of the Table, the limen given is in every case the last limen found for the subject and substance, and all the last limina found are given. The second part of the Table simply contains results selected by way of illustration, but all the limina found for the subject with the substance in question are included.

In Part 1, all the substances but the last four are taken in order from a Table in which Zwaardemaker arranges various materials for solid odorous cylinders in the order of their intensity.¹ The limina in the column headed Z are those given by him in another Table as normal at a temperature of 15° C., or 59° F.² The temperatures at which our records were taken lay for the most part between 60° and 70° F. Our limina ought, therefore, to be lower than his, instead of higher. We cannot satisfactorily explain the difference between our results and his in the matter of stimulus-limina. That the limina of Americans should be higher than those of Dutchmen is not indeed surprising, but the entire change in the rank of the substances is. According to Dr. Reuter, as cited by Zwaardemaker, the gum ammoniac and gutta-percha cylinder is forty times as strong as the vulcan-

¹ *Op. cit.*, p. 118.

² P. 167.

ized rubber, and the musk-root is five times stronger than the former. The tallow, Zwaardemaker says, is stronger still. We regret that we could not find stimulus-limina oftener. The washing of the tube consumed so much time that this was impossible. We feel that the results embodied in Table I are the most unsatisfactory part of our work. Yet if allowances be made for exhaustion in some of the results of *C.* and *Sh.*, and for expectation gradually controlled by practice in the cases of *Bi.*, *M.* and *Rog.*, the Table will serve its purpose.¹

We have not space to give our temperature records in full. They varied so irregularly that the arithmetical mean by no means represents the most common reading. As the steam had to be kept shut off when we were not in the laboratory, the exact regulation of the temperature involved serious practical difficulties, and for most of our work it was a matter of minor importance, for in difference-determinations variations of temperature and moisture affect the standard-stimulus and the stimulus of comparison equally, and may, therefore, be disregarded. Indeed, our barometer-records, though carefully kept, proved to be wholly a work of supererogation, for in the case of the very few substances (glycerine soap, coumarine, heliotropine, vanilline, and allyl sulphide) which were somewhat soluble in water and yet not in aqueous solution, we did not succeed in finding stimulus-limina on different days.² Practice lowered the stimulus-limina in a conspicuous manner, but the effect of variations in temperature can only occasionally be traced in the complete results. Part 2 of Table I illustrates this fact with fairness.

It only remains to say that *Be.*, *C.*, *K.*, *N.*, *Se.* and *T.* worked twice a week for at least part of the year and the others once.

Section 2. Results Obtained by the Method of Just Noticeable Differences.

Since in the nature of the case numerical proof of the applicability of Weber's law to a given sense department cannot be thrown into the form of averages, and since we have not space for the great mass of figures which we have at hand, we must offer first samples and then summaries of our evidence, and content ourselves with them. Tables II and III are the samples, and Tables IV, V and VI are summaries from different points of view. Table V constitutes the most decisive proof of the validity of the law. Tables V and VI are intended to confirm the conclusion to be drawn from Table IV, and to show the probable value of $\frac{\Delta r}{r}$. In Tables

III, IV, V and VI, *every value given or enumerated is an average* of the results of one day's work with one subject, nostril, substance and standard. All the work done with this method, however unsatisfactory, is represented in Tables V and VI.

¹ The writer's own limina are lower than those of any of the subjects. Abnormal keenness of smell has persisted from childhood, in spite of the usual share of "colds."

² For the effect of atmospheric moisture in Zwaardemaker's method, see Chapter I, Section 2.

TABLE II. CONSECUTIVE RESULTS OF ONE SUBJECT, T.

DATE.	SUBSTANCE.	Nostril.	No. of values averaged.	r	Δr_0	Δr_u	Δr	$\frac{\Delta r}{r}$	Disturbing factors.
Nov. 9,	Tolu balsam	R.	6	20	4(2)	7(3)	5½	4	
		L.			5(2)	5(1)	5	4	
13,		R.	6	30	2(1)	14(2)	8	4	
		L.			3(2)	9(5)	6	5	
16,		R.	3,4	20	1(1)	6(4)	3½	6 [Z]	
		L.	3,3		4(2)	4(2)	4	5 [Z]	
		R.	4	30	6(3)	8(2)	7	4	
		L.			4(2)	7(4)	5½	5	
19,		R.	4,3	20	4(1)	1(2)	2½	Z [Z]	
		L.	3,3		5(3)	6(4)	5½	4 [Z]	
		R.	4	30	6(2)	7(3)	6½	5	
		L.			4(4)	5(3)	4½	Z	
30,	Russian leather,	R.	4,2	24	7(2)	3(1)	5	5 [Z]	
		L.			6(1)	5(2)	5½	4	
		R.	4	44	8(2)	9(2)	8½	5	
		L.			10(3)	12(3)	11	4	
Dec. 10,		R.	4	24	3(2)	6(2)	4½	5	
		L.			6(4)	7(2)	6½	4	
		R.	4	44	6(4)	10(3)	8	6	
		L.			8(3)	11(4)	9½	5	
14,	Asafœtida,	R.	3	8	5(4)	4(1)	4½	A	
		L.			6(0)	7(1)	6½	A	
		R.	3	13	4(3)	10(2)	7	A	
		L.	2,3		5(1)	8(1)	6½	2 [2]	
	Russian leather,	R.	2	9	5(3)	—	—	— [Z]	Exhaustion.
		L.	3,1		4(2)	0(-)	2	5 [6]	
16,	Asafœtida,	R.	2,1	8	3(3)	6(-)	4½	A [Z]	{ General fatigue. Exhaustion. }
		L.	3,1		4(1)	3(-)	3½	2 [5]	
		R.	3	13	3(2)	6(2)	4½	3	
		L.	2,3		8(1)	5(2)	6½	2 [3]	
	Russian leather,	R.	3,2	9	6(4)	1(1)	3½	3 [3]	
		L.	3,1		5(1)	3(-)	4	2 [6]	
20,	Asafœtida,	R.	1,3	8	3(-)	3(2)	3	3 [Z]	Exhaustion.
		L.	1,1		3(-)	0(-)	1½	5 [-]	
		R.	3,2	13	6(1)	6(1)	6	2 [3]	
		L.	3,2		7(1)	3(2)	5	3 [3]	
	Russian leather,	R.	1,2	9	10(-)	1(2)	5½	A [6]	Exhaustion.
		L.	3,1		3(1)	1(-)	2	5 [Z]	
Jan. 8,	Cedar,	L.	4	22	8(2)	8(3)	8	3	Exhaustion.
11,		R.	4,2	22	8(2)	6(2)	7	3 [5]	{ Exhaustion. Pungency. }
		L.	3,4		6(3)	8(3)	7	3 [4]	
		L.		42	11(1)	10(1)	10½	4	
22,	Asafœtida,	R.	2	12	8(4)	8(0)	8	A	General fatigue.
		L.			5(3)	8(1)	6½	A	
		R.	2	22	14(2)	13(2)	13½	A	
		L.			8(1)	14(0)	11	2	
Feb. 1,		R.	3	22	8(2)	8(1)	8	3	
		L.			8(3)	8(3)	8	3	
		R.	3	12	10(1)	8(1)	9	A	
		L.			9(2)	7(1)	8	A	
5,	Coumarine,	R.	3	56	14(2)	7(4)	10½	5	
12,	Hellotropine,	R.	4	28	15(2)	11(0)	13	2	

TABLE II.—*Continued.*

DATE.	SUBSTANCE.	Nostril.	No. of values averaged.	r	Δr_0	Δr_u	Δr	$\frac{\Delta r}{r}$	Disturbing factors.
Feb. 12,	Heliotropine,	L.	3	48	13(1)	11(2)	12	2	
		R.			18(0)	17(1)	17½	3	
		L.			20(2)	15(1)	17½	3	
18,		R.	2	28	17(0)	13(0)	15	A	
		L.			14(2)	11(0)	12½	2	
		R.			18(1)	15(0)	16½	3	
		L.	2	48	19(5)	14(0)	16½	3	
		R.			13(0)	10(0)	11½	2	
		L.			12(1)	8(1)	10	3	
		R.	2	47	19(1)	14(3)	16½	3	
		L.			16(-)	9(2)	12½	4	
		R.			13(1)	8(0)	10½	3	
Mar. 1,	Valerianic acid,	L.	3	27	12(2)	8(0)	10	3	General fatigue.
		R.			18(1)	15(0)	16½	3	
		L.			18(0)	15(1)	16½	3	
		R.	3	18	15(2)	9(1)	12	A	{ Pungency. } { Exhaustion. }
		L.			14(2)	7(3)	10½	A	
		R.			18(1)	13(1)	15½	3	
		L.	2,3	18	16(2)	9(2)	12½	3	
		R.			13(1)	3(2)	8	2	
		L.			12(1)	4(2)	8	2	
		R.	2	38	16(2)	6(4)	11	4	
		L.			18(-)	5(0)	11½	3	
		R.			15(2)	4(-)	9½	A	
		L.	2,1	18	15(3)	3(2)	9	2	{ General fatigue. } { Nose-bleed during the day. }
		R.			24(2)	11(-)	17½	2	
		L.			20(1)	11(0)	15½	3	
		R.	2,3	18	11(1)	5(1)	8	2	{ Irritation of nasal membranes. } { Exhaustion. }
		L.			12(0)	—	—	—	
		R.			16(1)	10(4)	13	3	
		L.	2	18	17(1)	10(3)	13½	3	{ Irritation of nasal membranes. } { Smell of tobacco. }
		R.			13(1)	7(2)	10	A	
		L.			13(0)	7(1)	10	A	
		R.	3,2	38	16(1)	13(1)	14½	3	{ Irritation of nasal membranes. } { Homatropin freshly put into the eyes. }
		L.			18(1)	11(2)	14½	3	
		R.			8(1)	5(2)	6½	2	
		L.	3,2	28	8(1)	4(2)	6	2	
		R.			13(0)	8(-)	10½	3	
		L.			12(2)	7(1)	9½	3	
		R.	1,2	13	7(-)	0(0)	3½	4	
		L.			8(1)	2(1)	5	3	
		R.			12(0)	4(2)	8	4	
Apr. 16,		L.	2,3	28	12(1)	5(2)	8½	3	

7. whose results seem best fitted to be used as an illustration, worked twice a week, as a rule, during the time covered by this Table. No difference-determinations obtained from her during this time by the method of just noticeable differences have been omitted. In October, we worked with her once a week, but were occupied chiefly in finding stimulus-limina. She also worked for us several hours late in the spring with results which did not differ materially from those embodied in the table. The fourth column of the Table gives the number of values averaged to obtain the figures given in the columns headed

Δr_0 and Δr_w . If two figures stand on a line in the fourth column, the first refers to Δr_0 and the second to Δr_w . One figure refers not to both together but to each alike. The numbers in parentheses are all mean variations. A dash in parentheses means that the number by which it stands is not an average. In the column headed $\frac{\Delta r}{r}$, for the sake

of brevity values greater than $\frac{1}{4}$ are indicated by the letter A; values equal to $\frac{1}{4}$ or less, but nearer to $\frac{1}{4}$ than to $\frac{1}{8}$, are indicated by the figure 2; values equal to $\frac{1}{8}$ or nearer to $\frac{1}{8}$ than to $\frac{1}{4}$ or to $\frac{1}{8}$, by the figure 3; values equal to $\frac{1}{8}$ or nearer to $\frac{1}{8}$ than to $\frac{1}{4}$ or to $\frac{1}{8}$, by the figure 4; values equal to $\frac{1}{8}$ or nearer to $\frac{1}{8}$ than to $\frac{1}{4}$ or to $\frac{1}{8}$, by the figure 5; values equal to $\frac{1}{8}$ or greater, but nearer to $\frac{1}{8}$ than to $\frac{1}{4}$, by the figure 6; and values less than $\frac{1}{8}$, by the letter Z. Every subject sometimes moved the cylinder beyond the standard, and the reading, if taken at all, could be written only as a minus quantity. This crossing of the standard almost never occurred with the fluid-mantle olfactometer, and when it did the error was so easily explained that the reading was not taken. Between November 9 and the time when the liquids were first used, two sets of averages were obtained, the first by excluding and the second by including these negative quantities when they occurred. In Tables IV, V and VI, only values representing no negative quantities and differing from averages of the same series with the addition of such quantities by less than $\frac{1}{4}$ are included in the enumeration. The averages enclosed in square brackets in Table II were found by including minus quantities in the average values of Δr_0 and Δr_w . From all unbracketed averages, negative quantities are excluded. A dash in square brackets indicates that the corresponding value of Δr is itself a negative quantity.

The effect of some of the disturbing factors which are constant can best be illustrated in connection with this Table. Besides exhaustion, adhesion, and the tendency to judge in terms of hand-movement, which we call for short "the movement-error," some obstruction of the nasal passages, some slight compensating-smells, such as that of the absorbent cotton used to wipe the inhaling-tube, and some distraction of the attention in manipulating the large instrument, must be taken for granted with all the subjects. Only marked exhaustion is expressly noted in Table II. Another source of error which comes into operation with asafetida, oil of mace, Russian leather, and all the liquids except coumarine, heliotropine and musk is the escape of odor between the cylinder and the tube. The effect of this circumstance, which was mentioned in Section 2 of Chapter 2, must be to make the value of $\frac{\Delta r}{r}$ too large, because it makes the standard larger

than the instrument indicates. If, for example, r on the instrument is 20 mm., but really is 25 mm., and Δr is found to be 5 mm., then $\frac{\Delta r}{r}$ will be nominally $\frac{1}{4}$ while really it is $\frac{1}{5}$.

As we explained in discussing the disadvantages of the method of just noticeable differences, the effect of the movement-error is to make the value of $\frac{\Delta r}{r}$ smaller for the larger

standards, and thus to conceal the operation of Weber's law. If we look now at the values of $\frac{\Delta r}{r}$ in Table II, we shall see at

a glance that this variation exists. It should be noted that no variation in the order of the standards will eliminate the movement-error. If the smaller standard is given first and a certain habit of movement acquired, this habit will make $\frac{\Delta r}{r}$

for the larger standard too small. If the habit is acquired in connection with the larger standard, it will make $\frac{\Delta r}{r}$ for the

smaller too large. It is true that if the standards were alternated by single determinations, rather than by short series, a habit of movement would be less likely to establish itself, but such a procedure is excessively confusing to the subject in the case of smell, and, moreover, all work done with the smaller standard after the organ is blunted with the larger is more or less unsatisfactory. If the distance between the standards and the stimuli offered as decidedly greater or less were kept not absolutely but relatively equal, the movement-error would be concealed. The fact that these distances cannot be kept absolutely equal, if the stimulus of comparison is to be accepted as such by the subject, is in itself no small confirmation of Weber's law. As a matter of fact, they were kept as nearly equal as possible, both to avoid concealing the movement-error and to minimize exhaustion by strong stimuli. They often varied in the same series as the subject's organ became blunted to all differences and then recovered itself, but in general for a standard of 10 or 15 mm., the difference was made 10 mm.; for a standard of 20 or 30, 15; for a standard of 40 or 50, 20, and for a standard of 60 or 70, 25.

The moving back and forth at the limen is some safeguard against the error, yet the tendency of $\frac{\Delta r}{r}$ to be smaller

for the larger standards is apparent in the results of subjects whose attention was good and whose movements were careful. Thus, it is particularly well-marked in the work of *Se.*, who was certainly not inferior to any of our subjects. Moreover, the same tendency showed itself when the different standards were used on different days, and a habit in such nice adjustments could scarcely persist from day to day or week to week with so little practice. If (1) the movement-error is one explanation of the variation, (2) the escape of odorous vapor is in some cases another. The equal though unmeasured increment is a larger fraction of the smaller standard than of the larger. If our standards are 20 and 40 and the increment is 4, while

$\frac{\Delta r}{r} = \frac{1}{4}$ in both cases, then Δr will be 6 in one case and 11 in the other, and we must write the values of $\frac{\Delta r}{r} \frac{2}{3}$ and $\frac{1}{3}$.

We believe that (3) a fortuitous circumstance in connection with the standard olfactometer is another factor in the same result. Usually, the last movement made by the subject is an outward movement. He moves from a point decidedly different from the standard to subjective equality, and then a little way back again,—in and out once or oftener. In moving the cylinder the hand is apt to slip, and the accidental increment to Δr is a larger fraction of the smaller standard than of the larger. Adhesion is not a factor in the case, for it is larger for the larger standard, varies with the length of the determination, has an opposite effect upon Δro and Δru , and is balanced in an indefinite way by exhaustion.

It should be noted in Table II that at first Δru is usually slightly larger than Δro , but that with practice this variation is reversed. The natural effect of exhaustion is to make Δro larger than Δru , for exhaustion does not affect the standard stimulus and stimulus of comparison equally, but progresses all the time that the latter is manipulated. This tendency is in a manner checked by the time-error and by adhesion. (See Chapter I, Section 4.) Now *Be.*, the one subject who had had some experience in smell-experiments before the beginning of this course, tended from the first to make Δro greater than Δru . All the other subjects at first made Δru greater than Δro , but all except *Rog.*, *Se.* and *Sh.* changed the tendency with practice or began to do so. *Rob.*, *N.* and *T.* altered it very soon and decidedly. With *Se.* the values were usually almost equal. This alteration with practice seems to show that exhaustion causes more disturbance than adhesion and the time-error put together. This is what we should expect, for although the subject rested while the tube was being cleaned, yet the removal of adhesion was absolute, while the recuperation of the organ was less complete each time.¹ We never can be quite sure, however, whether exhaustion is really decreasing the strength of stimuli regularly, or is blunting all differences or making all movements haphazard. When a subject complained that his nose felt "hot," "dry," "rough," "scrapy," "sore," or "numb," his movements were often erratic, and the smaller stimulus sometimes seemed as strong as the larger, which probably stunned the already weary organ instantly. The dryness, no doubt, was due to the vigorous breathing. The tongue of a fever-patient will become much more parched and black if respiration through the nose is obstructed.

The original tendency to make Δro decidedly smaller than Δru , and the difficulty of finding the lower stimulus-limen are probably due to the same cause. Both cumulative stimulation and memory after-images might produce the tendency, though both would be counteracted in a measure by the moving to and fro at the limen. Against both, the subject would learn to guard in a measure. *Be.* mentioned "after-images" of cocoa-butter, and *Se.* of tolu balsam. Frequently a subject would complain that he could not "get the strong smell out of his nose."

¹ Zwaardemaker: *op. cit.*, pp. 203-204.

In the mean variations, as a whole, it is impossible to trace any tendency to be larger in judgments made with reference to the larger standard. Though the larger standard was usually given last, the effect of exhaustion in producing erratic judgments towards the end of the hour seems to have been balanced by a certain lack of practice. At the beginning of the hour, there is a sort of conscious awkwardness, characteristic of these smell-judgments when first attempted. It is impossible to draw from our figures any conclusion in regard to the delicacy of quantitative sensible discrimination in smell. The variations were evidently controlled to a great extent by the peculiarities of the instrument and the subject's habit of movement, and it must be confessed that from day to day the effect of practice upon them was not very clearly marked. All the subjects had smaller mean variations when using the fluid-mantle olfactometer, but this fact can hardly have been due to practice, for, although the other instrument was used first in every case, *Rob.*, *Rog.* and *T.* returned to it after using the large instrument for a while, and showed the same mean variations as they did at the beginning. Moreover, the difficulty of turning the screw-head of the large instrument and

TABLE III.

Complete Results for One Solid and One Liquid Substance.

SUBSTANCE.	SUBJECT.	VALUES OF $\frac{\Delta r}{r}$
Gray rubber,	Be.	$\frac{17}{88}, \frac{17}{88}, \frac{22}{74}, \frac{19}{74}, \frac{14}{88}$ w. $\frac{17}{74}$ and $\frac{35}{117}$, $\frac{7}{88}$ w. $\frac{21}{74}$ and $\frac{29}{117}$
	D.	$\frac{8}{88}$ w. $\frac{22}{74}, \frac{18}{88}$ w. $\frac{19}{88}$
Coumarine,	Se.	$\frac{14}{84}$ w. $\frac{18}{82}, \frac{15}{84}$ w. $\frac{19}{82}, \frac{15}{84}$ w. $\frac{18}{82}, \frac{14}{84}$ w. $\frac{20}{82}$
	Be.	$\frac{16}{82}, \frac{14}{84}$
	Bi.	$\frac{12}{82}$ w. $\frac{17}{72}, \frac{12}{82}$ w. $\frac{17}{72}, \frac{16}{82}$ w. $\frac{24}{72}, \frac{12}{82}$ w. $\frac{23}{72}$
	C.	$\frac{24}{84}, \frac{17}{82}, \frac{25}{82}, \frac{23}{82}$ w. $\frac{25}{82}, \frac{25}{82}, \frac{23}{82}$ w. $\frac{29}{82}$, $\frac{19}{82}$ w. $\frac{27}{82}, \frac{17}{82}$ w. $\frac{27}{82}$
	D.	$\frac{14}{82}$ w. $\frac{18}{72}, \frac{15}{82}$ w. $\frac{19}{72}$
	K.	$\frac{30}{72}$ w. $\frac{17}{72}, \frac{20}{72}$ w. $\frac{27}{72}, \frac{18}{72}$ w. $\frac{29}{72}$
	M.	$\frac{24}{82}, \frac{23}{82}, \frac{20}{82}$ w. $\frac{29}{82}, \frac{17}{82}$ w. $\frac{25}{82}, \frac{16}{82}$ w. $\frac{28}{82}$
	N.	$\frac{15}{117}, \frac{12}{117}, \frac{26}{72}$ w. $\frac{27}{117}, \frac{20}{72}$ w. $\frac{26}{117}, \frac{18}{82}$ w. $\frac{26}{117}$, $\frac{18}{72}$ w. $\frac{24}{117}$
	P.	$\frac{24}{72}$ w. $\frac{26}{117}, \frac{21}{72}$ w. $\frac{26}{117}$
	Rob.	$\frac{25}{72}$ w. $\frac{38}{132}, \frac{27}{72}$ w. $\frac{38}{132}, \frac{19}{72}$ w. $\frac{21}{82}, \frac{16}{72}$ w. $\frac{43}{82}$, $\frac{14}{82}$ w. $\frac{25}{82}, \frac{18}{82}$ w. $\frac{25}{82}$
	Rog.	$\frac{11}{82}$ w. $\frac{20}{82}, \frac{18}{82}$ w. $\frac{21}{82}, \frac{20}{82}$ w. $\frac{23}{82}, \frac{19}{82}$ w. $\frac{23}{82}$
	Se.	$\frac{17}{82}$ w. $\frac{23}{82}, \frac{17}{82}$ w. $\frac{28}{82}, \frac{21}{82}$ w. $\frac{26}{82}, \frac{26}{82}$ w. $\frac{23}{82}$
	Sh.	$\frac{38}{82}, \frac{27}{132}, \frac{11}{82}$ w. $\frac{23}{82}, \frac{11}{82}$ w. $\frac{23}{82}$
	T.	$\frac{21}{117}$

the propensity of the movable cylinder of the small instrument for slipping are quite enough to explain the fact. The mean variations of *Rob.*, *Rog.*, *Se.* and *Sh.* closely resembled those of *T.*, both in size and in degree of uniformity. Those of *Be.*, *Bi.*, *C.*, *M.* and *N.* ran higher, and were more irregular. This fact was undoubtedly due to hasty movements in the cases of *Bi.*, *C.* and *M.*, and to exhaustion in the cases of *Be.* and *N.* *D.*'s mean variations were large and irregular in the beginning, but improved with his manner of moving the cylinder, and *K.*'s also were large at first, but finally approximated to *T.*'s. *P.*'s were suspiciously small, as small with the fluid-mantle as with the standard olfactometer, and indicated the movement-error beyond a doubt.

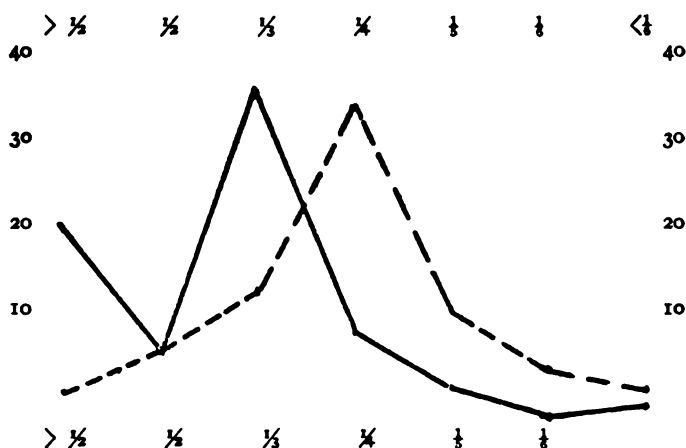
Results connected by *W.* ("with") were found on the same day for the same nostril. The values obtained with gray rubber were chosen for illustration because vulcanized rubber was used with three different methods, and those obtained with coumarine were taken because this scent was used with all the thirteen subjects. Both sets are fair samples of the whole mass of results. The series of *Be.* and *D.* with gray rubber, and of *Bi.*, *C.*, *K.*, *M.*, *N.*, *Rob.* and *Sh.* with coumarine, give pretty clear indications of the validity of Weber's law. That of *Se.* with rubber, and those of *D.*, *P.*, *Rog.* and *Sh.* with coumarine, indicate the operation of the law simply by the fact that as a rule the numerators of the fractions with the larger denominators are larger. The series of *Be.* and *T.* with coumarine are too short to prove anything by themselves. A series in which the numerators of the fractions with the larger denominators are persistently smaller than those of the fractions with the smaller denominators or equal to them may be counted as tending to disprove the law.

In the complete set of results—counting the results of one subject with one substance as one series—there are 55 series for solids. Out of these, 15 indicate Weber's law clearly; 14 indicate it faintly; 11 long

TABLE IV.

Approximate Values of $\frac{\Delta r}{r}$ obtained for Pairs of Standard Stimulus-Intensities Sensed under the Same Conditions,—viz:
Subject, Nostril, Substance, and Hour.

$\frac{\Delta r}{r}$	(1) $r=a$	(2) $r=2a$ or $2a+$	(2) $r=a$	(2) $r=a$ $a+(a$	(1) $r=a$	(1) $r=2a$ or $2a+$	(2) $r=a$	(2) $r=a$ $a+(a$
A. V.	C.	C.	C.	C.	C.	C.	C.	C.
$\frac{1}{2}$ (A)	20	3	14	11	10		7	1
$\frac{1}{2}$ (2)	7	7	5	5	35	1	14	4
$\frac{1}{3}$ (3)	34	13	7	10	35	57	46	32
$\frac{1}{4}$ (4)	9	32	21	7	6	34	17	32
$\frac{1}{5}$ (5)	3	11	9	12	3	3	3	12
$\frac{1}{6}$ (6)		5	4	3	5		1	4
$\frac{1}{6}$ (Z)	1	3	1	13	1		2	5
Total,	74	74	61	61	95	95	90	90



CURVES ILLUSTRATING THE VALUES OF $\frac{\Delta r}{r}$ FOR SOLIDS WHEN $r = a$
AND $2a$ OR $2a+$. (See Table IV.)

series are of doubtful interpretation; 13 series are too short to prove anything; and 2 tend to disprove the law. Out of 39 series for liquids, 24 indicate the law clearly, and 11 do so faintly, while 3 are too short to count, and only 1 tends to disprove the law.

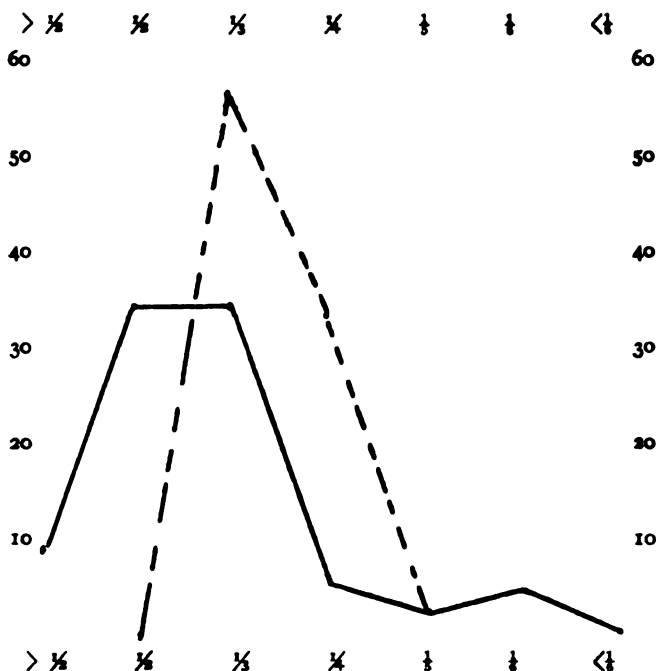
We may now proceed to the Tables which summarize the evidence.

As noted before, Table IV enumerates only values for standards which can be paired as sensed under the same conditions. The left column of each pair of columns enumerates values obtained for the smaller standards in the pairs. The columns headed (1) enumerate values for standards of which one was twice as strong as the other, or more than twice as strong. The columns headed (2) enumerate values for standards of which one was less than twice as strong as the other. All values obtained for standards which can be paired are included. *A. V.* stands for "Approximate Values," and *C.* for "Cases."

We believe that we have accounted for the tendency of $\frac{\Delta r}{r}$

to be somewhat smaller for the larger standards. In Table IV, however, it is clear that the errors to which this tendency is due do not serve to conceal the operation of Weber's law. If certain absolute differences of smell-intensity were sensed and $\frac{\Delta r}{r}$ for a given standard were $\frac{1}{3}$, then for a standard twice as strong it should be $\frac{1}{6}$, not $\frac{1}{4}$.

Tables V and VI are arranged to show such variations as occur from subject to subject, and substance to substance. That it may be seen that each subject used a variety of substances, and that the different subjects used the substances in different



CURVES ILLUSTRATING THE VALUES OF $\frac{\Delta r}{r}$ FOR LIQUIDS WHEN $r=a$
AND $2a$ OR $2a+$. (See Table IV.)

Of these curves, the heavy lines give the values for the smaller, and the broken lines for the larger standards. The ordinates give the number of cases, and the abscissæ approximate values.

orders, we preface the Tables with the following list of substances as used in order by each subject:

Be. Black rubber, tolu, cocoa-butter, asafoetida, Russian leather, gray rubber, coumarine, heliotropine, valerianic acid, citral.

Bi. Cocoa-butter, coumarine, vanilline.

C. Gum benzoin, oil of mace, cedar, coumarine.

D. Gray rubber, gum benzoin, oil of mace, coumarine, oil of camphor.

K. Tolu, rose-wood, asafoetida, Russian leather, gum ammoniac and gutta-percha from Utrecht, oil of mace, coumarine, musk, ethyl butyrate.

M. Cocoa-butter, coumarine.

N. Black rubber, tallow, musk-root, rose-wood, oil of mace, heliotropine, oil of camphor, vanilline.

P. Gum ammoniac and gutta-percha, home-made, glycerine soap, oil of mace, coumarine, oil of camphor.

Rob. Glycerine soap, gum ammoniac and gutta-percha, home-made, oil of mace, coumarine, vanilline, cedar, gum ammoniac and gutta-percha from Utrecht.

Rog. Black rubber, paraffine, coumarine, oil of camphor, caryophylline, gum benzoin, oil of anise, laudanum.

Se. Tolu, rose-wood, tallow, asafoetida, musk-root, gray rubber, oil of mace, coumarine, musk, ethyl butyrate, citral, caryophylline, allyl sulphide.

Sh. Black rubber, cedar, gum ammoniac and gutta-percha, from Utrecht, coumarine, oil of camphor.

T. Tolu, Russian leather, asafoetida, cedar, coumarine, heliotropine, valerianic acid, citral, pyridin and yellow wax.

The fact that the order was not varied more extensively and more systematically was due to practical difficulties with the apparatus.

TABLE V. APPROXIMATE VALUES OF $\frac{\Delta r}{r}$ ARRANGED TO SHOW VARIATIONS FOR INDIVIDUAL SUBJECTS.

Subject.	Nature of Stimuli	Number of Cases { approximating } or equal to							Total number of cases.
		$\geq \frac{1}{2}(A)$	$\frac{1}{2}(2)$	$\frac{1}{2}(3)$	$\frac{1}{2}(4)$	$\frac{1}{2}(5)$	$\frac{1}{2}(6)$	$< \frac{1}{2}(2)$	
Be.	S.	6	9	4	6	3	1		29
	L.	5	5	16	5	5	1	1	38
Bi.	S.				4	4	1	3	12
	L.		1	9	4	1	3	2	20
C.	S.	6	2	7	3	5	1	2	26
	L.		3	6	3				12
D.	S.	9	4	3	6	1			23
	L.		7	6	3				16
K.	S.	3	6	13	5	1			28
	L.	2	6	12	9			1	30
M.	S.						1	2	3
	L.	1	2	4	1				8
N.	S.	4	2	13	13	5	3	8	48
	L.	1	1	10	7	3		2	24
P.	S.			5	4	2	1	2	14
	L.			3	6	4		3	16
Rob.	S.	16	4	10	11	1	2		44
	L.	2	1	8	7	1	1		20
Rog.	S.		1	4	5	5	3		18
	L.		1	21	6	3		1	32
Se.	S.	8	4	11	14	10	3	2	52
	L.	1	19	40	29	3			92
Sh.	S.			2	2	4		4	12
	L.		1	9	3	4		1	18
T.	S.	8	5	11	13	10	2	2	51
	L.	6	11	24	6	1	4		52
Total,		78	95	251	175	76	27	36	738

It will be seen that there is very little variation in the value of $\frac{\Delta r}{r}$ from class to class of substances. All of Zwaardemaker's

classes are represented among either the solids or the liquids except Class IX, that of nauseating smells. We could not obtain *Anagyris foetida* or Indian stink-wood ("Scatolholz") in the American market, and we did not try soon enough to get it from Europe. Variations in the results of individual subjects are, however, due to variations in the substances used.

TABLE VI.

Approximate Values of $\frac{\Delta r}{r}$ arranged to show Variations for Different Substances.

PART I. SOLIDS.

SUBSTANCE.	Number of cases { equal to or approximating }							Total number of cases.
	$>\frac{1}{2}(A)$	$\frac{1}{2}(2)$	$\frac{1}{2}(3)$	$\frac{1}{2}(4)$	$\frac{1}{2}(5)$	$\frac{1}{2}(6)$	$<\frac{1}{2}(Z)$	
Yellow wax. I,	—	1	3	4				8
Russian leather. I,	2	4	3	5	6	1		21
Oil of mace. II,	25	11	10	4				50
Cocoa-butter. II (?),		3	2	5	5	3	5	23
Rosewood. II,	1		10	10	2	1		24
Cedar. II,			9	2	3		4	18
Tolu balsam. III,			2	8	6	2	2	20
Gum benzoin. III,	6	2	8	6	5	2	1	30
Musk-root. IV,		1	6	7	2	1	3	20
Black rubber. V,		1	4	5	6	4	6	26
Gray rubber. V,		2	4	10	5		1	22
Asafoetida. V,	14	6	5					25
Gum ammoniac and gutta-percha.								
(1) Weaker cylinder fr. Utrecht,	1	3	4	3	2		1	14
(2) Stronger cylinder fr. Utrecht,	1	1	5	7	1	1		16
(3) Home-made cylinder, Paraffine. VII,	10	2	1		1		1	15
Mutton-tallow. VII,				3	3	2		8
Glycerine soap,			5	3	4			12
			2	4		1	1	8
Total,	60	37	83	86	51	18	25	360
Values for oil of mace, asafoetida, and home-made cylinder of gum ammoniac and gutta-percha,	49	19	16	4	1		1	90
Final result,	11	18	67	82	50	18	24	270

TABLE VI.—Continued.
*Approximate Values of $\frac{\Delta r}{r}$ arranged to show Variations for
 Different Substances.*

PART II. LIQUIDS.

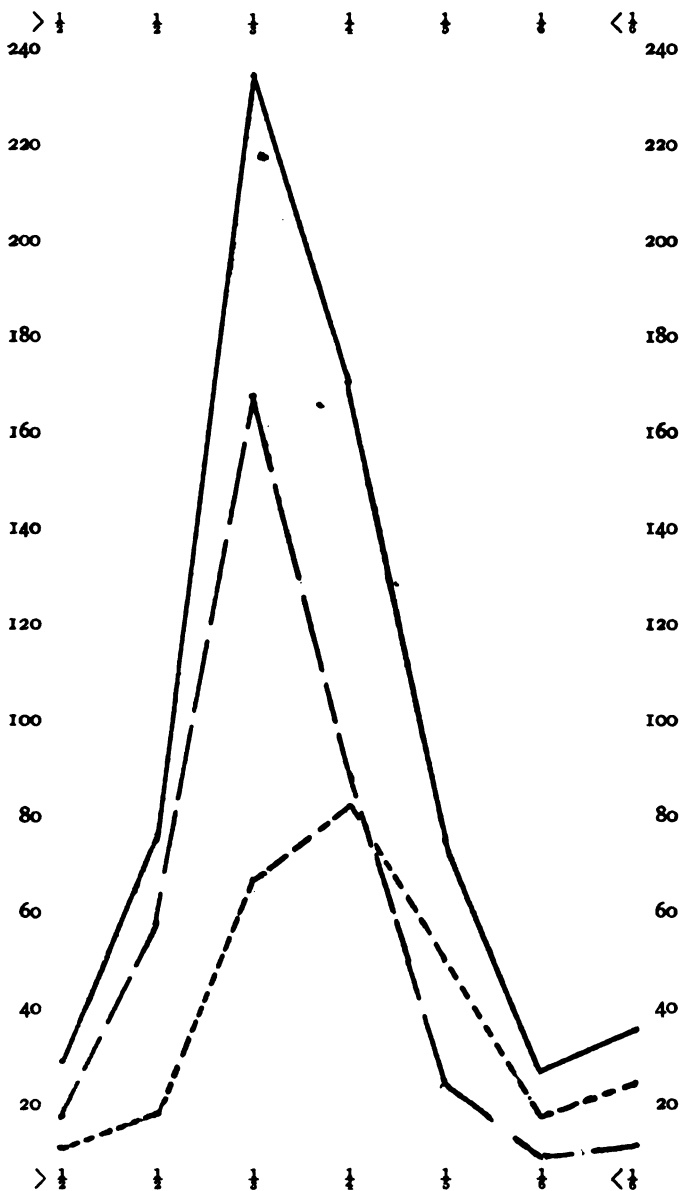
SUBSTANCE.	Number of cases { equal to or approximating }							Total number of cases.
	$>\frac{1}{2}(A)$	$\frac{1}{2}(2)$	$\frac{1}{2}(3)$	$\frac{1}{2}(4)$	$\frac{1}{2}(5)$	$\frac{1}{2}(6)$	$<\frac{1}{2}(Z)$	
Oil of camphor. II,	1	7	26	8	6			52
Caryophylline. II,	1	2	10	5	2			20
Oil of anise. II,			6	1	1			8
Valerianic acid. II,	10	7	12	2				31
Ethyl butyrate. II,	2	10	8	6				28
Citral. II,		8	26	9	1			44
Vanilline. III,			10	7	1	4	2	24
Coumarine. III,	3	11	34	31	7		3	89
Heliotropine. III,	1	4	14	3	6	1	1	30
Musk. IV,		2	15	6	1			24
Allyl sulphide. V,		5	3	8				16
Pyridin. VI,			2	2		4		8
Laudanum. VIII,			2	1			1	4
Total,	18	58	168	89	25	9	11	378

PART III. SOLIDS AND LIQUIDS.

Nature of Stimulus.	Number of cases { equal to or approximating }							Total number of cases.
	$>\frac{1}{2}(A)$	$\frac{1}{2}(2)$	$\frac{1}{2}(3)$	$\frac{1}{2}(4)$	$\frac{1}{2}(5)$	$\frac{1}{2}(6)$	$<\frac{1}{2}(Z)$	
Solid,	11	18	67	82	50	18	24	270
Liquid,	18	58	168	89	25	9	11	378
Total,	29	76	235	171	75	27	35	648

Almost all the values for solids in which $\frac{\Delta r}{r}$ exceeds $\frac{1}{2}$ were

obtained with asafœtida, oil of mace, or the home-made cylinder of gutta-percha and gum ammoniac. Thus, out of 9 values in which $D.$ exceeded $\frac{1}{2}$ for solids, 7 were found with oil of mace, and out of 16 values in which $Rob.$ exceeded $\frac{1}{2}$, 10 were found with the home-made cylinder of gutta-percha and gum ammoniac, and 4 with oil of mace. We believe that it is perfectly fair to exclude these cylinders from our final results. And if we do so there is little variation from substance to substance. The odor of asafœtida and oil of mace was very perceptible when the instrument was closed, and the mace would



CURVES SHOWING THE APPROXIMATE VALUES OF $\frac{\Delta r}{r}$ IN THE WHOLE COURSE OF EXPERIMENTS BY THE METHOD OF JUST NOTICEABLE DIFFERENCES. (See Table VI, Part 3.)

The heavy line gives the values for both solids and liquids; the dotted line gives the values for solids, and the broken line for liquids. The ordinates give the number of cases, and the abscissae approximate values.

scrape off on the inhaling-tube. While Zwaardemaker's mixture of gum ammoniac and gutta-percha is black and brittle like licorice, ours was yellowish gray, contained strings of gutta-percha, and made the inhaling-tube cloudy and sticky. We did succeed in obtaining stimulus-limina with it when the inhaling-tube was first cleaned, but we believe that the end of the tube was probably soiled most of the time during difference-determinations. We have not excluded the results for Russian leather because its odor, like that of most of the liquids, was just liminal when the instrument was closed, and the results harmonized with the others. Since most of the liquids had this error of the equal but unmeasured increment, it is not surprising that the values of $\frac{\Delta r}{r}$ run higher for them than for

solids. It will be noticed that they run highest for valerianic acid, which was particularly troublesome in escaping from the instrument. Yet as the results for coumarine, heliotropine, and musk show $\frac{1}{3}$ as the most common value, we must conclude that the value of $\frac{\Delta r}{r}$ lies somewhere between $\frac{1}{3}$ and $\frac{1}{4}$.

Some of the substances showed an interesting difference of quality with difference of intensity. Thus several subjects thought that oil of camphor smelt like nutmeg when weak, and like turpentine when strong. The slight odor of the paraffine appeared when a strong stimulus was given with coumarine. T. said that heliotropine smelled like heliotrope on the left (the better) side of her nose, and like bitter-almonds on the right. (As a matter of fact the two smells are closely allied.) Se. said that the tallow smelled like onions in his poorer nostril. Fluctuations at the limen were also noted. Coumarine and heliotropine, when weak, were said to come "in whiffs" or "waves," and K. always spoke of weak smells as "scattered."

Section 3. Results of Other Methods.

Table VII gives some of the results obtained by the method of just noticeable differences modified in the direction of the method of minimal changes, as described in Chapter I, Section 4, and shows the agreement of these results with those reached by the ordinary method. C. M. stands for "Combination Method."

We used red rubber with the true method of minimal changes because Zwaardemaker had done so. The cylinder was obtained from Utrecht. The experiments of which the results are given in Table VIII extended through five laboratory-hours. It is needless to say that the instrument was manipulated entirely by the experimenter.

TABLE VII.

Results of the Modified Form of the Method of Just Noticeable Differences.

SUBJECT.	SUBSTANCE.	METHOD AND Standard	NOSTRIL	No. values Averaged.	$\Delta ro'$	$\Delta ro''$	$\Delta ru''$	$\Delta ru'$	Δro	Δru	Δr	$\frac{\Delta r}{r}$
D.	Gray rubber,	{ C. M. }	R.	4	9	8	6	10	9	8	$8\frac{1}{2}$	2
		{ r=19 }	L.		11	8	3	7	10	5	$7\frac{1}{2}$	3
		{ C. M. }	R.	4	18	9	3	11	14	7	$10\frac{1}{2}$	4
		{ r=39 }	L.		18	9	4	8	14	6	10	4
		{ J N D }	R.	4					2	6	4	5
		{ r=19 }	L.						7	6	$6\frac{1}{2}$	3
		{ J N D }	R.	4					12	10	11	4
		{ r=39 }	L.						9	10	$9\frac{1}{2}$	4
K.	Rose-wood,	{ C. M. }	R.	3	15	5	2	11	10	7	$8\frac{1}{2}$	3
		{ r=22 }	L.		11	6	3	16	9	10	$9\frac{1}{2}$	2
		{ C. M. }	R.	4	14	4	5	8	9	7	8	5
		{ r=42 }	L.		12	6	9	14	9	12	$10\frac{1}{2}$	4
		{ C. M. }	R.	2	10	5	7	10	8	9	$8\frac{1}{2}$	3
		{ r=22 }	L.		8	7	8	4	8	6	7	3
		{ C. M. }	R.	2	10	6	3	9	8	6	7	6
		{ r=42 }	L.		11	6	4	10	9	7	8	5
		{ J N D }	R.						9	9	9	3
		{ r=22 }	L.						13	15	14	Δ
		{ J N D }	R.						8	16	12	4
		{ r=42 }	L.						7	14	$10\frac{1}{2}$	4

TABLE VIII.

Results obtained for Red Rubber by the True Method of Minimal Changes.

SUBJECT—SH.

$r=20$ mm.			Gradation = 2 mm.		
$\Delta r^A = 40$ mm.			$\Delta r^V = 4$ mm.		
r_1 given before r .			r given before r_1 .		
R. N.	$\Delta ro'$	$\Delta ro''$	Δro	$\Delta ro'$	$\Delta ro''$
L. N.	6	6	6	12	6
	6	10	8	6	8
R. N.	$\Delta ru'$	$\Delta ru''$	Δru	$\Delta ru'$	$\Delta ru''$
L. N.	12	6	9	6	12
	8	4	6	8	12
	Δr	$\frac{\Delta r}{r}$	Δr	$\frac{\Delta r}{r}$	
R. N.	$7\frac{1}{2}$	$\frac{1}{10} = \frac{1}{10} +$	9	$\frac{1}{10} = \frac{1}{10} -$	
L. N.	7	$\frac{1}{10} = \frac{1}{10} +$	$8\frac{1}{2}$	$\frac{1}{10} = \frac{1}{10} +$	
Final result: R. N. $\Delta r = 8\frac{1}{2}$ mm. $\frac{\Delta r}{r} = \frac{1}{10} = \frac{1}{10} +$					
L. N. $\Delta r = 7\frac{1}{2}$ mm. $\frac{\Delta r}{r} = \frac{1}{10} = \frac{1}{10} +$					

Zwaardemaker concluded that for a standard of from 2 to 5 cm., the difference limen was about 1.5 cm., and that for a standard of from 5 to 9 cm., it was about 3.5 cm. This would make the value of $\frac{\Delta r}{r}$ run from about $\frac{1}{3}$ to about $\frac{3}{4}$. Our

own results agree fairly well with his, and are a very pretty confirmation of the results obtained by the method of just noticeable differences. The writer intends to use the method of minimal changes much farther.

In contrast with these excellent results are those of the next Table :

TABLE IX.

Results obtained by the Method of Right and Wrong Cases.

SUBJECTS—C., D., E., N., ROB., ROG., AND T.

Instrument—Standard Olfactometer. Substances—*Black Rubber or Tolu Balsam.*

r AND r_1 .	RIGHT CASES.	WRONG CASES.	MISTAKES MADE IN TAKING THE SECOND STIMULUS FOR WEAKER WHEN STRONGER.	TOTAL NUMBER OF CASES.
20 and 25	37	19	12	56
50 and 70	30	10	9	40
20 and 30	47	19	12	66
30 and 50	33	11	5	44
20 and 40	42	22	18	64
30 and 60	4	2		6
20 and 50	39	11	8	50
20 and 60	7	1	1	8

The stimuli given were never equal, and the judgment "equal" was counted a mistake. The results of all the subjects are massed.

As we said before, while exhaustion makes the errors nearly all run in one direction, confusion due to the unfamiliarity of olfactometric work is probably most at fault. More experiments should be made with the standard olfactometer and trained subjects. It is difficult to use the large olfactometer with this method, because the intervals between stimuli must be made very long or the subject can guess from the time spent in manipulation how they have been changed.

As a rough method of testing the applicability of the method of right and wrong cases to smell, we blind-folded one subject, stopped his ears with absorbent cotton, and required him to tell which way we had moved from a given standard on the large olfactometer. The results are given in the following Table :

TABLE X.

Results of a Rough Attempt to Gauge the Applicability of the Method of Right and Wrong Cases to Smell.

SUBJECT—K.					SUBSTANCE—ETHYL BUTYRATE				
Change.	Correct judgments of direction.	Incorrect judgments of direction.	Failures to note change or to distinguish its direction.	Total number of cases.	Change.	Correct judgments of direction.	Incorrect judgments of direction.	Failures to note change or to distinguish its direction.	Total number of cases.
Mm. 20 to 30	95	46	11	152	Mm. 40 to 60	100	35	6	141
20 to 10	115	27	6	148	60 to 40	106	29	5	140

We see that here again the number of mistakes was very large. Yet these were the last experiments made with K., who had worked for us twice a week throughout the year, and who had used butyric ether successfully in experiments by the method of just noticeable differences. He was, however, very tired at the time these last experiments were made. The second stimulus still is more often mistakenly taken for the weaker than for the stronger, showing that in these experiments also exhaustion outweighed adhesion and the time-error put together. (The tube was cleaned after every eight comparisons.)

SUMMARY AND CONCLUSION.

In beginning our investigations, we saw that we could not isolate simple olfactory qualities, and that an attempt to prove Weber's law for smell was justified only by the assumption that it might apply to fusions. We also saw that the fact that some olfactory qualities show but few grades of intensity pointed to a rise towards the terminal intensity by geometrical progression. Although Zwaardemaker explains the fact partly by the supposition that different smells have different difference-limina, we believe that two smells with the same difference-limen may exhaust the human sense-organ with very unequal degrees of rapidity, so that one may reach the terminal intensity much sooner than the other.

Aside from the condition of the sense-organ, the intensity of a smell depends (1) on the amount of odorous surface exposed to the air, (2) on the time that it is exposed, (3) on the condition of the air in regard to temperature, moisture, etc., which controls the rate of evaporation, (4) on the diffusion-rate of the

vapor, and (5) on the rate and manner of the subject's breathing. The great incidental difficulties in olfactometric work are (1) the variability of the organ through obstruction by mucus or (2) exhaustion, (3) the adhesion of the odorous matter to parts of the apparatus, and (4) the presence of compensating smells. The freedom of the nasal passages may be tested, but exhaustion can neither be prevented nor measured, nor can adhesion and the presence of compensating odors be absolutely excluded. We employed Zwaardemaker's olfactometric method in which (1) the measure is the amount of odorous surface exposed, (2) the time of exposure may be disregarded, (3) the diffusion-rate of vapor is under control, and (4) the subject's breathing is supposed to be self-regulating. We did not (5) succeed in regulating the temperature of our laboratory, but its variability was not of primary importance in difference-determinations. Adhesion makes the method of minimal changes impracticable for most substances with Zwaardemaker's method of smell-measurement, and exhaustion contributes to make the method of right and wrong cases very difficult. We therefore used the method of just noticeable differences. This psychophysical method involves an error from the subject's tendency to judge in terms of hand-movement. Another occasional source of error, incidental to our apparatus, was the escape of some odors between the inhaling-tube and cylinder. Both of these circumstances tend to make the values of $\frac{\Delta r}{r}$

smaller for the larger standards. Adhesion and the ordinary time-error tend to balance exhaustion. In spite of the four most serious sources of error, (1) exhaustion, (2) adhesion, (3) the movement-error, and (4) the unmeasured increment to some stimuli, we found $\frac{\Delta r}{r}$ to be about $\frac{1}{3}$ in 36% and about

$\frac{1}{4}$ in 26% of our determinations. It was about $\frac{1}{2}$ in 12%, about $\frac{1}{3}$ in 12%, about $\frac{1}{4}$ in 4%, greater than $\frac{1}{2}$ in 5% and less than $\frac{1}{4}$ in 5% of the determinations. The slight use we made of the other gradation-methods confirms the general result. There is no great variation from one substance to another, or from one of Zwaardemaker's classes to another.

There is much yet to be done and said in olfactometric work—"of making of books there might be no end"—but we believe that enough has been said and done to offer some evidence that Weber's law applies to smell and that the value of $\frac{\Delta r}{r}$ lies between one-third and one-fourth.

MINOR STUDIES FROM THE PSYCHOLOGICAL LABORATORY OF CORNELL UNIVERSITY.

COMMUNICATED BY E. B. TITCHENER.

XVII. CUTANEOUS PERCEPTION OF FORM.

By D. R. MAJOR, PH. D.

The object of the following experiments was the determination of the limits of form at various parts of the cutaneous surface. Although the investigation is not yet concluded, it seems worth while to publish the results so far gained: especially as there is no literature upon the subject (*cf.* Henri, *Raumw. d. Tastsinnes*, 1898, p. 53).

The forms employed were angles, open circles, filled circles and filled triangles. The *angles* (of 35°) were made by fastening strips of sheet rubber to wooden handles. The lengths of side used were 3 to 10 mm., inclusive. The *open circles* were cut from glass tubing (thickness of glass about .5 mm.), the cut edge of which was ground. The outside diameters ranged between 2 and 11 mm. The *filled circles* were made from solid glass rods, in the same way: diameters 2 to 12 mm. The *triangles* (equilateral) were cut from hard rubber blocks, and fastened to wooden handles: sides 2 to 9 mm. In each series the increment of difference was 1 mm. The method employed was that of just noticeable stimuli, as described by Kuelpe (*Outlines of Psych.*, pp. 55 f.). The subject closed his eyes, and the form was pressed firmly down upon the skin, at the place selected. As soon as the subject had cognised (or definitely failed to cognise) a form, he opened his eyes, and drew upon paper a figure which corresponded to the cutaneous perception. The judgment of cutaneous form was thus recorded in terms of a visual translation. This procedure recommended itself in view of the fact that movement was above all things to be avoided; we were investigating the cutaneous, not the tactual appreciation of form. It may be said at once, however, that one of the subjects (G), who is of the tactual type and has small power of visualization, could hardly be restrained from movement (wrinkling the skin, shifting the fingers, etc.,) in spite of all cautions. With the other two subjects no such difficulty was found.

The subjects—Dr. I. M. Bentley (B), Dr. E. A. Gamble (G), and Dr. W. Manahan (M)—were all trained in psychological methods, and knew in a general way the object of the present enquiry. The procedure with knowledge was, of course, followed in experimentation. *B* soon became aware that only four forms were being employed; *G* and *M* showed no trace of any positive opinion on the matter. The surfaces tested were the tip of the tongue, the tip of the middle finger of the right hand, and the central portions of the red areas of upper and lower lips. It was a mistake to work upon all four with the same forms in a single investigation, since information gained from the points of greater discrimination is almost inevitably transferred to other points, whose limina are thus unduly lowered. The results proved that the dimensions taken were not small enough, in the following cases: angles, on the tongue and under lip; open circles, on the tongue; filled triangles, on the tongue. (The results from *G*, where they stand alone, throw no light on this question, for the reason given above.) On the other hand, the dimensions were too small to allow of liminal determinations on forehead, cheek, ball of thumb, and volar side of wrist. No other surfaces were tried.

Results. The following Tables show the results for the three subjects on the four surfaces. Under *L* is given the average form limen; under *m. v.* the average departure of the single determinations from *L*; under *no.* the number of single determinations made. It must be remembered that a single determination implies the performance of experiments in two directions, ascending and descending; so that, *e. g.*, 10 *L*'s required 20 series of experiments. The *m. v.*'s of the partial limina were very small; hence neither they nor the limina themselves are shown in the Tables. The thick figures indicate that the limit of the instrument was reached, or, in other words, that the recorded *L* may be too large.

TABLE I.
Tip of tongue. Unit 1 mm.

Subject.	Λ ¹			○			●			▲ ¹		
	L.	M. V.	NO.	L.	M. V.	NO.	L.	M. V.	NO.	L.	M. V.	NO.
B	5	1	8	2	—	4	6	1.3	3	3	.5	10
G	3	—	10	2	—	4	4	1	5	2	—	8
M	3	—	10	2	—	4	4	1	4	2	—	8

¹On tongue and lips these figures were placed always with the apex pointing upwards or downwards upon the longitudinal axis of the body. Variation of direction made no difference in judgment. On

TABLE II.
Tip of finger. Unit 1 mm.

Subject.	Λ			○			●			▲		
	L.	M. V.	NO.	L.	M. V.	NO.	L.	M. V.	NO.	L.	M. V.	NO.
B	4	.7	11	3	.3	3	5	1	3	4	1	4
G	5	.8	10	2	—	4	4	.7	4	4	1.1	7
M	5	1.3	6	4	1	3	6	1.3	3	5	2.3	6

TABLE III.
Upper lip. Unit 1 mm.

Subject.	Λ			○			●			▲		
	L.	M. V.	NO.	L.	M. V.	NO.	L.	M. V.	NO.	L.	M. V.	NO.
B	5	.6	8	3	.5	4	6	2	5	6	2	11
G	4	.4	8	2	—	3	5	1.2	4	5	1.3	9
M	4	.6	9	3	.7	4	6	1.5	4	5	.7	6

TABLE IV.
Lower lip. Unit 1 mm.

Subject.	Λ			○			●			▲		
	L.	M. V.	NO.	L.	M. V.	NO.	L.	M. V.	NO.	L.	M. V.	NO.
B	4	1	5	3	.2	4	6	1.5	3	7	2.1	7
G	3	—	9	2	—	3	5	1.5	4	4	1	6
M	3	—	6	3	.3	3	6	1.7	4	7	2	5

It appears from these Tables that, within the limits of our experiments, *the surfaces tested rank*, as regards capacity of form cognition, in the order: *tip of tongue, tip of finger, lips*. (Between upper and lower lip there is no appreciable difference.) It appears further, that the cutaneous surfaces differ in their behavior according as the stimuli are surfaces or outlines: thus the lips are at a disadvantage when the filled circle and the triangle are applied. A different selection of stimuli might therefore lead to a different order of rank. The fact is brought out in Table V, which is obtained by massing the results from the three subjects.

the finger tip, all four possible positions were employed. Unfortunately, we have no separate records for the longitudinal and transverse directions. The introspective notes, however, show (for all three subjects) that cognition was subjectively a little easier when the forms lay transversely upon the surface.

TABLE V.
Limina of form in mm.

PLACE.	Λ	○	●	▲
Tongue . . .	3.7	2	4.7	2.3
Finger . . .	4.7	3	5	4.3
Upper lip . .	4.3	2.7	5.7	5.3
Lower lip . .	3.3	2.7	5.7	6
Av.	4	2.6	5.3	4.5

We see from these figures that the *form most easily cognised* by the four surfaces *is the open circle*. It is, perhaps, hardly safe to draw any general conclusion from them as to the order of cognition of the remaining three forms. We may remark, however, that the filled circle was as unsatisfactory as the open circle was satisfactory to work with. This accounts for the smaller number of series given for these two forms in the Tables.

Practice—in some cases extending over a month—was given with each instrument for each place upon the skin. Its effect was twofold. Practice at a given spot increased the subject's power of discrimination (or rather cognition) of form at that spot.¹ And practice at a spot of finer discrimination was, as we have said above, of influence upon the cognition of form at spots of coarser discrimination. The latter fact is clear from our introspective records, especially from those of *B*. There can be no doubt that the influence was enhanced by the character of the method employed, *i. e.*, by the requirement of translation from haptics into optics.

It need hardly be said that the value of a limen is never an absolute value. Limina will vary as the conditions of experimentation vary. Our subjects had all had general practice, and worked according to a procedure with knowledge. While we have reason to think that the limina of these three subjects would have been practically the same if obtained by a procedure without knowledge, experiments (not yet completed) upon subjects lacking in general practice promise to give a higher limen, particularly by a procedure without knowledge. They indicate, too, that the values will differ with the admission or rejection of visualization.

Subliminal judgments. The following Tables show the

¹The values given by Titchener (*Outline of Psychology*, p. 164)—triangle, 3.5 mm. on tongue, 7 mm. on finger-tip—are massed values taken from our three subjects at what proved to be about halfway through the stage of practice. On the theory of practice see Henri, *Raumw. d. Tastsinnes*, pp. 27 ff.; Tawney, *Phil. Stud.*, xiii, 163 ff.

nature of the subliminal judgments of form passed by the three subjects. They tell their own tale of individual tendency.

TABLE VI.
Subliminal judgments. Tip of tongue.

SUBJECT.	Λ	●	▲
B	∪	Blur.	● or blur.
G	Λ ¹	Blur.	
M	● ¹	Blur.	

TABLE VII.
Subliminal judgments. Tip of finger.

Subject.	Λ	●	▲	○
B	○ or ∪	Blur.	●	Blur.
G	— or Λ	○	— or Λ	
M	— or Λ	Blur.	Λ	Blur.

TABLE VIII.
Subliminal judgments. Upper lip.

Subject.	Λ	●	▲	○
B	∪ or Blur.	Blur.	Blur.	Blur.
G	— or Λ	Blur.	— or ○	
M	∪	—	● or ◐	Blur.

TABLE IX.
Subliminal judgments. Lower lip.

Subject.	Λ		▲	○
B	∪ or Blur.	Blur.	Blur.	Blur.
G	— or Λ ¹	○	— or Λ or Λ	
M	● or ∪ ²	Blur.	● or ∪	Blur.

¹ In practice experiments.

² In practice experiments.

PSYCHOLOGICAL LITERATURE.

The Origin and Growth of the Moral Instinct, by ALEXANDER SUTHERLAND. London: Longmans, Green & Co., 1898. 2 vols., pp. 797.

The volumes are well printed—an excellence of no small moment to the much taxed modern eye. Other superficial excellences are: 'A comprehensive table of contents, an ample index, and a preliminary chapter outlining the scope and method of work.

In the preface the author makes special acknowledgment of indebtedness to Darwin and Adam Smith. To the former he owes the general direction of his ethical thinking and, more particularly his method of investigation and demonstration. "Full half of the book is a detailed expansion of the fourth and fifth chapters of his *Descent of Man*." "His (Darwin's) progress in these chapters reminds us of the march of some active and brilliant general who outlines a great conquest, but leaves behind him many a fort, and city, and strong place, to be subsequently beleaguered by plodding officers, each concluding in his own province, by time and labor, what his commander had effectively done in design." To the latter he owes the more definite direction of his thesis. "Adam Smith would in all likelihood have revealed the origin of our moral instincts, had he only possessed a mere suspicion of that greatest of biologic truths which Darwin was subsequently to establish. He saw that morality was founded on sympathy, but nowise perceiving whence that sympathy could possibly be derived, the whole remained involved as much in mystery as ever."

The author thus states his thesis: "It is the purpose of this book to show, how from the needs of animal life as they rose and developed, there sprang, at first with inexpressible slowness, but imperceptibly quickening as it advanced, that moral instinct which, with its concomitant intelligence, forms the noblest feature as yet visible on this ancient earth of ours." He waives all the "grander and deeper" philosophic considerations that encompass his enquiry, and devotes himself solely to tracing "the growth of our moral instincts from their humble source among the lower animals, with absolutely unbroken continuity through lowliest savage to the noblest of men, always as a biologic process."

The book presents three stages of treatment. In the earlier chapters the growth of sympathy is traced. Parental care is adduced as the condition of the "emergence, the survival, and subsequent ascendancy of the more intelligent types." The second stage of the argument shows how sympathy having "thus entered on its first humblest existence," has deepened and expanded, giving rise to "the moral instinct, with all its accompanying accessories, the sense of duty, the feeling of self-respect, the enthusiasm of both the tender and manly ideal of ethic beauty." Finally, there is the exposition of a theory of the physiological basis of those emotional susceptibilities which we collectively call by the name of "sympathy." (This theory coincides

very nearly with the "visceral theory" of Prof. James, but was formulated in ignorance of Prof. James's work.)

The thesis is supported by a wealth of detailed evidence drawn from the widely varying fields of zoölogy, physiology, anthropology, history, jurisprudence and philosophy.

As a scientific history of "the growth of our moral instinct" this book has two elements of weakness. In the first place, it is an apology and not strictly a history. Adam Smith's doctrine of "morality founded on sympathy" is assumed as a proposition to be demonstrated. Under such conditions an impartial investigation of the facts of moral evolution would be well nigh a superhuman task. In the second place the author's evident disregard of psychology is a grave defect. You scan the index in vain for a citation from a "simon pure" psychologist. This disregard is especially exasperating in view of the author's use of such indefinite psychological terms as "instinct" without even a provisional definition. His treatment, too, of sympathy is somewhat invertebrate. It is defined as "that general tendency which makes men grieve at the pains and rejoice in the pleasures of their fellows," the capacity of contagiousness in emotion." The physiological conditions of sympathy are set forth with admirable and convincing thoroughness; but the psychological conditions, which can hardly be of less significance in the history of the progressive development of sympathy, are not mentioned. As a matter of fact, the history of the origin and growth of the moral instinct is essentially a chapter in the history of psychogenesis. In the hands of one not a psychologist the subject is bound to suffer.

More specific points of criticism are the failure to take account of the sex factor in the origin of sympathy, which seems to be ascribed wholly to parental instinct; and the practical ignoring of the heredity problem. The author seems to hold to the Darwinian doctrine of transmission. Weissmann is not mentioned.

On the whole this book adds little to clear thinking along the line of moral evolution; but on the other hand it has not a little of moral dynamic in itself. Its purpose is dogmatic, but the controversial temper is generally absent; and a kind of noble idealism permeates all the pages.

W. S. S.

Animal Intelligence: An Experimental Study of the Associative Processes in Animals, by E. L. THORNDIKE. Monograph Supplement, No. 8, of the Psychological Review.

This monograph of 109 pages presents the results of a series of experiments conducted for two years on dogs, cats and chicks, with a view to ascertain the time required and mode in forming their mental associations, together with a determination of their delicacy, number and permanency.

The method used was to confine the animals in enclosures from which they could escape by some simple act, such as pulling at a loop of cord, pressing a lever, or stepping on a platform. The animals, as far as possible, were kept in a uniform state of hunger. This, together with the desire for freedom and discomfort in confinement, were the factors played upon throughout.

He found that the creatures could not learn to do any act from being put through it, "and that no association leading to an act could be formed unless there was included in the association an impulse of the animal's own. Learning, whether among domestic animals or their keepers, is a process in which the learner must shoulder the great bulk of the task.

The interpretations that will probably provoke discussion and

adverse criticism are the following: 1st, that animals, excepting primates, cannot and do not learn the simplest acts from seeing their fellows do them; 2nd, "that the elements in the associative processes are sense-impressions, plus a past 'impulse and act,' rather than between two sense-impressions, one past, and one present." He would argue, if I interpret him aright, that in order for the product of the associative processes to be advantageous to increase intelligence, one of the elements must be an impulse from the motor side as opposed to the idea which maintains that the associative elements in animal psychosis may be between sensations or even between memory images of an elaborate order. For those of us who have an abiding interest and faith in comparative psychology as an important auxiliary to the study of mind, the chief value of the paper lies in its testing a simple method whereby more of the facts of animal psychosis may be set forth.

L. W. KLINE.

A Primer of Psychology, by EDWARD BRADFORD TITCHENER. The Macmillan Co., N. Y., 1898. Price, \$1.

A good elementary text-book is by no means easy to write; it is a most searching test both of the real condition of the science for which it is written and of the degree in which the writer has mastered his subject. To write up "results" for Archives or technical journals is one thing, to distil off the vital essence of a science for beginners is quite another. Such a book ought not to be a mere description of the "wonders" of the science in question, still less an abstract account of its theory; it must show the theory alive and luminous in phenomena actually present.

The peculiar merit of Prof. Titchener's primer is the successful attempt to do just this. The general treatment is not only concrete and sufficiently untechnical, but each of the fifteen chapters is followed by a section of "Questions and Exercises," intended to lead the student not only to the better comprehension of the text, but also to an intelligent observation of his own mental experiences. When practicable these observations are given an experimental form, and an appendix is devoted to a convenient list of apparatus and materials, with names and addresses of makers, and prices.

The book, however, covers a much wider field than that of laboratory psychology. After introductory chapters on the nature and methods of the science, the topics of sensation, feeling, and attention are taken up in that order, to be followed by those of perception, idea and association, emotion, simpler forms of action; then memory and imagination, thought and self-consciousness, sentiment, and complex forms of action; the work is concluded by a chapter on abnormal psychology, and another on animal and child psychology and the relation of psychology to ethics, logic and pedagogy. As will be seen from this list, the order of treatment is somewhat peculiar. In the reviewer's opinion it is not altogether happy,—certain logical and systematic advantages having been gained at the expense of a natural pedagogical approach.¹

The present state of psychological science is apparent in the varying interest of the chapters, those upon matters little touched as yet by the newer methods being painfully skeletonesque. For this, of course, the author cannot be held responsible. It is to be regretted, however, that he did not give more explicit attention to mental

¹ It is perhaps fair to say that the plan is simpler than the chapter headings would suggest, being the usual threefold division treated successively at different levels of complexity: 1, Sensation, Feeling, Attention; 2, Perception (with idea and association), Emotion, Simple Action; 3, Higher Intellect, Sentiment, Complex Action.

hygiene based upon psychological principles, especially as the book is intended for normal and high school students. A few minor inaccuracies also and inadvertencies of expression might well receive attention in another edition; *e.g.*, on p. 33 it seems to be implied that imagination is dependent on changes of blood supply, on pp. 44-45 in considering giddiness the otolith organs are mentioned, but the semicircular canals are not, and on p. 50 the intensity of moonlight is taken much too high. The book is valuable enough, however, to carry off many more than these deficiencies, and will, no doubt, prove extremely helpful even to many above the level for which it was first designed.

E. C. S.

The Influence of High Arterial Pressures Upon the Blood-Flow Through the Brain. W. H. HOWELL. *American Journal of Physiology*, I. (1898), 57-70.

The physiology of the cerebral circulation is a difficult and obscure matter, and has been made even more difficult of comprehension by the supposition that, because the brain itself is practically incompressible and encased in an inextensible skull, any enlargement of the arteries under increased blood pressure must bring about a corresponding compression of the veins, which would hinder the outflow of the blood, and, in case of a sudden and great rise of arterial pressure, might produce anæmia by preventing it altogether. Recent experiments by several observers, however, have made clear that this reasoning was somewhere at fault, for when the arterial pressure in living animals has been made very high by the administration of drugs, the outflow has not been diminished. Prof. Howell has carried these experiments further, and, it would seem, entirely closed the question by showing in the case of dogs previously killed, that even very great pressures (*e.g.*, 500 mm. of mercury, or about 9.7 lbs. per square inch) do not cause any decrease of the outflow from the cerebral veins; in other words that "the circulation in the brain behaves in this respect precisely as it does in the other organs of the body; the greater the arterial pressure the more abundant is the flow of blood." The arterial enlargement is indeed compensated by compression of the veins (and they even show a pulse, due, apparently, to the increase of compression at each arterial pulse) but their total bore is considerably greater than that of the arteries, so that they are never seriously occluded, while the large sinuses, which might suffer more, are protected by tough dural sheaths.

E. C. S.

On the Relation Between the External Stimulus Applied to a Nerve and the Resulting Nerve Impulse as Measured by the Action Current. C. W. GREENE. *American Journal of Physiology*, I. (1898), 104-116.

Experiments were made on the excised nerves of frogs, terrapin, cats and dogs. The curves for the relation of the stimulating current and current of action, plotted from the results, show three stages: The first rising sharply from the abscissa and practically straight, the third also straight and nearly parallel to the abscissa, and the second, a curve with its concavity toward the abscissa, connecting the other two. The first stage extends from the smallest stimuli awakening any response up to the intensity required to bring out maximal muscular contractions and considerably beyond; it is the expression of an arithmetical ratio, each increase in stimulus bringing out a proportional and decided increase in the current of action. The third also represents an arithmetical ratio, but the increase for each unit of stimulus, while still proportional, is quite small. In the nerves of

dogs the author finds, as Waller found for the nerves of frogs, that the first straight portion of the curve is preceded by a short curved portion, convex toward the abscissa. The point of interest for psychophysics lies in the fact that, so far as inference from these experiments is justifiable, the relation of stimulus and sensation generalized by Weber's law (which many have considered a matter of neural physiology) lies in the activity of some other portion than the nerve fibre.

E. C. S.

The Functions of the Ear and the Lateral Line in Fishes. FREDERIC S. LEE. *American Journal of Physiology*, I. (1898), 128-144.

As a basis for discussing the relation of the ear and the organs of the lateral line Dr. Lee summarizes the results of his admirable studies on the equilibration sense and the ear, already published, together with others not as yet published in detail. The ear of fishes performs both dynamical and statical functions. The dynamical are: First, recognition of rotations (mediated by the semicircular canals and their nervous mechanisms), and second, recognitions of movements of translation (mediated by the otolith organs of the utricle, saccule and lagena). The statical function, recognition of position in space (gravity sense), is also mediated by the otolith organs. An ear might seem to imply hearing, but this is not the case in fishes,—Lee's experiments, like those of Bateson and Kreidl, showing these creatures to be without hearing in the ordinary sense of the word, though sensitive to jars.¹

Lee has also experimented on the lateral line organs in dog-fish, toad-fish and butter-fish with results that point strongly to an equilibrative function as that of these organs also, which agrees with the morphological derivation of the ear from a specialized group of these line organs.

What has probably been the evolutionary history of the developed ear of higher forms is thus sketched by the author: "The primitive function, not improbably, was the appreciation of movements of the water against the body and movements of the body in the water, combined with appreciation of contact, and, hence indirectly and crudely, of position in space; by the exercise of this function, through functional connection with the locomotor mechanism, the equilibrium of the body was maintained. In some unknown way a bit of this sensory system became cut off from the rest and enclosed within the skull; it still retained its power of appreciating bodily movements and contact, and this power became refined and differentiated; the capacity of appreciating rotary movements was separated from that dealing with progressive movements and position in space, and the two were associated with distinct organs, the semicircular canals on the one hand, and the otolith organs on the other, which were appropriately constructed to subserve their respective functions. Thus, a well-marked sensory organ for equilibrium was evolved in fishes. When aquatic animals began to leave the water and live a shorter or longer time upon the land, and the possible advantage of a sense of hearing was presented, a portion of this sensory organ of movement became still farther differentiated; a new patch of sensory nerve-terminations

¹ Lee summarizes one of Kreidl's studies as follows: "In a subsequent paper Kreidl explodes the oft-repeated tale of hearing by fishes that come for their food at the sound of a bell, by investigating carefully the action of trout at the famous old Benedictine monastery in Krems, Austria. He proved that the fishes come because they see the man who brings the food, and appreciate the vibrations of the water caused by his step and communicated through the stone basin; and that, when these are excluded, the sounds of the bell have no effect."

appeared, the papilla acustica basilaris; apparatus for conveying the waves in the air directly to the membranous ear was developed; and thus the power of appreciating the movements we call sound was acquired."

E. C. S.

I limiti del pudore nell'uomo e nella donna. Pio VIAZZI. Riv. mens. di Psich. forense, Antrop. crim., ecc. (Napoli), Vol. I (1898), pp. 164-175.

In this article, Viazzi, the author of a work on "Sexual Criminals," in which he sustained in detail the view that woman has a greater sense of shame than man, abandons that opinion, returning to the conviction of Sergi, that by reason of her less amorous sensibility, woman has necessarily less sense of shame than man, though she *seems* to evince and to display more. Woman's use of shame as a means of seduction,—shame in the sense of hiding or avoiding what would excite repugnance or disgust and endanger her amorous conquests; the graver consequences for her of the *côitus* and the social consequences of unchastity and infidelity, which cause not a little calculation to enter into her sense of shame, until ultimately it departs from the sphere of feeling and enters the region of deliberate reasoning as to consequences of lack of shame; the greater interest woman has over man in showing herself modest and shamefaced—all this lessens the amount of real shame-sense to be attributed to the female sex. A great deal of her apparent shame is merely the clever psychical counterfeit. The pallid frigidity of woman on certain occasions, may be the shadow of shame, but only the ghostly shade. Man's wider range of sexual reactions (shown also in the pathological side of love and its fetishisms) carries with it a greater bulk of shame. Low-necked dresses and exposed breasts still wait their analogues in the drawing room and the theater from men. Women are led to be shameless more easily than men, and shameless in public. For evolutionary reasons, a deeply-felt sense of shame, an organic sense of it are naturally stronger in the sex, whose ego is best protected and defended.

A. F. C.

Il dolore nell' educazione. L. M. BILLIA. Nuovo Risorgimento, Vol. VIII (1898), pp. 187-193.

The question whether man is free or not seems to be settled by the answer to the question: Can he inflict pain upon himself for a certain end? Not every pain, or all pain is educative, but without pain there can be no greatness, no virtue, no true happiness, no work, no science, no education. Study is pain, thought is pain, pain is virtue.

A. F. C.

The Origin of the Family. H. SOLOTAROFF. American Anthropologist, Vol. XI (1898), pp. 229-242.

The primary form of the family, according to M. Solotaroff, is "the mother free to contract or dissolve sexual bonds—and the group of children resulting from these sexual relations." The assertion of man's bio-psychic activities and individualities, and the growth, with the vicissitudes of environments of the need of sexual favors, help and protection for herself and her children "have led the woman slowly out of bondage of economic care for her family group, but led her into marital bondage, while the most powerful tendency toward socialization among primitive men, expressing itself in various ways, has incidentally expressed itself, also, in occasional sexual permissuity as the outcome of the ecstasies of play—one of the most potent instincts of the social sentiment." In his general views the author approaches Westermarck, rejecting the theory of primitive promiscuities.

A. F. C.

Piratical Acculturation. W. J. MCGEE. *Ibid.*, pp. 243-249.

The four stages or phases of acculturation are sketched by Professor McGee, as follows: "The *first* phase is characteristic of savagery; it is expressed in the imitation of weapons and symbols, with the esoteric purpose of invoking new deities; it may be styled *martial* acculturation. The *second* phase is characteristic of barbarism, though arising earlier and perishing later; it is expressed in semi-antagonistic mating between tribes, with the initial esoteric purpose of strengthening tribal pantheons; it may be called *marital* acculturation. . . . The *third* phase is characteristic of civilization, though it begins in barbarism and plays a role in enlightenment; it is expressed in interchange of goods with the purpose (at first esoteric and afterwards exoteric) of personal profit or gain; it may be designated *commercial* acculturation. The *fourth* phase is characteristic of enlightenment, though its beginnings may be found much lower; it is expressed in the spontaneous interchange of ideas for the purpose of increasing human power over nature; it may, provisionally, be styled *educational* acculturation." The first two phases are essentially piratical, the last two essentially amicable.

A. F. C.

The Factors of Heredity and Environment in Man. D. G. BRINTON. *Ibid.*, pp. 271-277.

After pointing out the divergence of scientific opinion upon the subject (Lombroso says "*milieu* can annihilate all ethnic traits," while Collignon holds to hereditary transmission of anatomical peculiarities," together with "a difference of brain, revealed by a special direction of the thoughts and the display of special mental powers"), Dr. Brinton emphasizes the fact that "the progress of man is his progress of gaining independence from nature, of making her forces his slaves, and not leaving them his masters"—hence "the dependence of man on his environment is not a fixed quantity," for "in the most favored spots to-day it is reduced almost to a zero, so far as its influence on man's higher, soul-life is concerned." Besides there are two psychical elements, temperament and character, which "are largely independent both of heredity and environment." Temperament, Manouvrier calls "the determining cause of the intellectual and moral traits of the individual," and character is "the essential personal element in humanity." It is neither inherited nor acquired, and "it probably begins with the very inception of the individual life;" while "in its essential traits it forever bides the same, resisting all external agencies;" it is that "which in the last analysis [as Wundt demonstrates] prompts the decisions, guides the actions, and carves the destiny of men and nations." The theories of atavism are weaker to-day than yesterday, and the advances in the study of cellular pathology have won whole territories for variation and the heredity of acquired characteristics. The peculiar traits of races may be pathological, the result of that perfect adaptation to one environment which brings in its train unfitness for any other. "Blood will tell," it is true, but just as much temperament and character.

A. F. C.

Familientypus und Familienähnlichkeiten. Graf THEODOR ZICHY. Correspbl. d. deutschen anthrop. Ges. (München), 1898, (Vol. XXIX), S. 41-44; 51-54.

An interesting study of the features of the Hapsburgs and the Bourbons. The author concludes: 1. Nearly everybody has the features of some near ancestor, but the whole series is necessary for perfect orientation. 2. An inherited family type is not infrequent,

but by no means the rule. 3. Between children of the same parents resemblances are frequent, but mostly only during youth. 4. The resemblances between parents and children are most noticeable in the youth of both. 5. Here and there very striking resemblances to very remote ancestors occur. A. F. C.

L'imitation dans l'Art. FELIX REGNAULT. Rev. Sci., 4e série, Tome X (1898), pp. 335-336.

Art has all along its history been prone rather to imitation than to invention—the former is easier. Relics of imitation and repetition are to be found in the symmetries of classic art and architecture.

Studien zur deutschen Weidmannssprache. PAUL LEMBEKE. Ztschr. f. den deutschen Unterr., XII. Jahrg. (1898), S. 233-277.

A valuable discussion of the vocabulary of the German "hunter's dialect," with appropriate consideration of such words (*helzen*, *Luder*, *naseweis*, *unbändig*, *Wildfang*, *Hundejunge*, *Hundsbebe*, *willern*, *stöbern*, etc.) and phrases (*durch die Lappen gehen*, *auf den Strich gehen*, etc.) which have passed into the literary language of the day, the student-language or other clannish forms of speech among the various social classes. It is interesting to note the influence of the "hunt" in a Mecklenburg dialect, where, e. g., the carouse after the hunt is called *Najagd*; a dance is *Klapperjagd*; distinguished people are *Hochwild*; *de lütt Jagd* ("little hunt") = when a player has many small trump cards; of an old maid they say *ut de jagdboren Johren is se rut* ("she's past her hunting time"). Many hunting proverbs are also noted. A. F. C.

L'Éducation Rationnelle de la Volonté, 'DR. PAUL ÉMILE LÉVY. Paris, Félix Alcan, 1898. pp. 231.

The thesis of this work is contained in the first sentence of the opening chapter. "We propose to show that it is possible to preserve our moral and physical being from many affections, and if any evil comes to one or the other to draw from our own nature relief or cure." The book is divided into two parts. (1), theoretical; (2), practical. The fundamental psychological law upon which the theory of autosuggestion is based is the fact that every thought is the beginning of action. The will acts more effectually when it acts unconsciously, or without effort, that is as a result of suggestion. Suggestion is of two kinds: suggestion from without, and autosuggestion; but there is no essential difference between these.

Many ailments of the body as well as of the mind are habits. Moral hygiene consists in the fixation in the organism of healthy physical and mental habits.

In the second part of the book many cases are given in detail of the cure by autosuggestion of emotional troubles, of habits, of functional disorders of circulation and digestion. While, according to Dr. Lévy, psychotherapy does not claim to be all there is of therapy, there are cases in which nothing can take its place, there are other cases in which it acts better than any other curative agent. And in all cases it is useful. G. E. PARTRIDGE.

Moderne Nervosität und ihre Vererbung, von CH. FÉRÉ. Arzt am Bicêtre. Durch Dr. Hubert Schnitzer, Berlin.

The book is chiefly a discussion of heredity as affected by nervous diseases. Féré asserts himself a follower of Darwin and an opponent of the Weismann theory of the continuity of the germ substance. His

position is that the conditions of life affect the individual organism, and exert an important modifying influence on the protoplasm.

The influence of heredity is far from being limited to psychic diseases. It extends also to the most organic and functional diseases of the nervous system, and, further, every nervous disease is connected with an anatomical change.

Interesting chapters dealing with degeneracy and hereditary asymmetry are given.

The book is especially valuable as a guide to the literature of the subject, a very large list of authors being cited.

The translator has done his work well. The lucid style of the French author is well maintained throughout in the translation.

NORMAN TRIPLETT.

Le Subconscient chez les Artistes, les Savants et les Écrivains, par le DOCTEUR CHABANEIX, médecin de la marine. Preface de M. le Docteur Regis. Paris, 1897. pp. 124.

In this preface Dr. Regis defines the "*Subconscient*" as the peculiar state between sleeping and waking; between the conscious and the unconscious.

It is this state that Dr. Chabaneix has studied in the cases of a number of authors, artists and scientists. Noting the frequency among such men of somnambulism, neuropathy, hallucinations, etc., the author was desirous of determining whether they were particularly subject to "subconscious" dreams, and if so, what part the subconscious played in their works. He gives the experience of Mozart, Goethe, Heine, Voltaire, Schopenhauer, Wagner, Tolstoi, and many other equally famous men, both historic and contemporary.

He shows that the subconscious appears with great frequency among men of talent and genius, and in the case of many it figures in their productions to a remarkable degree.

Dr. Regis says the study brings to light one of the psychologic conditions under which the great works of the human mind are produced. It establishes also that the personality of men of talent and genius so diversely interpreted, is more often due to nervous erethism than to mental derangement, and that the great creators are often lost in their subconscious abstraction.

The work contains a bibliography of some seventy titles; also a table of the authors cited.

The Use of Color in the Verse of the English Romantic Poets, by ALICE EDWARDS PRATT. Chicago: The University of Chicago Press, 1898. pp. 118.

This work is a thesis for the doctor's degree in the Department of English of Chicago University. The author presents an exhaustive study of the use of color by the seventeen principal English poets from Langland to Keats. The study includes the entire product of each poet considered, except Thomson; and the results have been catalogued and classified. The classification is made in two ways: According to color groups; and according to distribution among fields of interest. The tables and charts give a graphic representation of the subject. The work furnishes some suggestive material for the psychologist.

W. S. S.

Leitfaden der physiologischen Psychologie in 15 Vorlesungen. Von TH. ZIEHEN. 4te Aufl. Jena, G. Fischer, 1898. pp. 5, 263.

Professor Ziehen's *Leitfaden*, published in 1891, is well known to American students of psychology in the translation of Messrs. Beyer and Van Liew (2d ed., 1895). It is with this, in the absence of the 3d

German edition, that the reviewer must compare the present volume. The following are some of the more important changes: Lecture II, "Sensation, Association, Action," has new paragraphs on the development of the brain in the vertebrate series; Lecture III, "Stimulus, Sensation," a new derivation of Fechner's measurement-formula, and modifications in the discussion of Weber's law; Lecture IV, "Taste, Smell, Cutaneous Sensations and Sensations of Movement," a paragraph on the static sense and the alimentary organic sensations; Lecture V, "Sensations of Hearing," remarks on the timbre of vowels; Lecture VI, "Sight" (the whole lecture has been revised, with the assistance of Professor Koenig), paragraphs on visual perceptions of movement and on certain optical illusions; Lecture VII, "Temporal Attributes and Affective Tone of Sensations," added remarks on after-images, references to the time-sense, and changes in matter and arrangement throughout the second half of the lecture; Lectures IX and X, minor additions in the discussion of emotion and of association of ideas; Lecture XI, paragraphs on the activity experience in attention, and on the relation of attention to intensity of sensation; Lecture XIV, new matter in the paragraphs dealing with the development of action and with simple reaction experiments; Lecture XV, consideration of objections to the associative theory of will. The new indices, of subjects and authors, are most welcome, as are the numerous citations of recent literature in the foot notes.

It is plain, from this summary, that the fourth German is a great improvement upon the second English edition of the *Leitfaden*. It is regrettable that Professor Ziehen has seen fit to retain the polemical treatment of Wundt's apperception theory in text and preface. He has, apparently, never understood that theory; though a reading of the *Grundriss* and *Vorlesungen*, in their recent issues, would be amply sufficient to show him that he has misrepresented Wundt's doctrine.

E. B. T.

Yetta Ségal, by H. J. ROLLIN. New York, G. W. Dillingham & Co., 1898. pp. 174.

Yetta Ségal is a novel, the aim of which is to familiarize the public with the idea of race-mixture as the final step in the mental and physical development of mankind. In the course of the story an American Jewess marries a man who is part American, part negro, and part Spaniard; and a Japanese woman, one of whose grandparents was European, finds a husband who is half English and half Swede.

With the merits of the story as story we are not here concerned. There can, however, be no doubt of the psychological importance of the fact upon which the author—apart from his references to the Antilles and citations of Herbert Spencer—lays stress: the fact that, in a civilized community, "positive assurance is now impossible as to the racial purity of any individual."

L'Enseignement Intégral, ALEXIS BERTRAND, Professeur de Philosophie à l'Université de Lyon. Félix Alcan, Paris, 1898.

"Unified instruction" is really, according to the author, instruction in all the human sciences for every human being. This book is another and strong appeal for reform in the lack of popular education. Whatever secondary education exists, is not well suited to all classes. There is an aristocracy of learning, whereas there should be perfect equality. No provision is made for the instruction of the sons and daughters of mechanics, laborers and farmers, and these, the mass of the people, are as capable as any of profiting thereby. The great gap comes between the ages of thirteen and twenty.

Descartes and Comte, as national philosophers, are taken as guides

in support of the new movement; for the proposed system is partly in operation in Lyon and other cities. In the author's outline for popular secondary education Comte is roughly followed, and according to this philosopher there are three periods in positive education. The first is purely physical and under the mother's direction. The second, between the ages of seven and fourteen, is æsthetic; the study of the arts and languages. The third is scientific, conforming closely to the "hierarchy of the seven fundamental sciences." These sciences are arranged in a logical series; mathematics, astronomy, physics, chemistry, biology, sociology, and morals. The study of the classics brings in a bifurcation, fatal to an utilitarian and unified instruction. The introduction of co-education marks probably the greatest innovation in the proposed new system.

This secondary instruction in the sciences would be given in two schools; the first or institutes, would be evening schools, and the course would last seven years. The second, the colleges, would differ from the first only in that the students devote full time to study and finish in four years. Chapter three gives the details of the author's unique plans for these schools.

F. D. SHERMAN.

Introduction to Herbartian Principles of Teaching, by CATHARINE I. DODD, of Day Training Department, The Owens College, Manchester, 1898. London: Swan, Sonnenschein & Co.; New York: The Macmillan Company. pp. 198.

The author of this work has fittingly prefaced it with an introductory notice by Dr. W. Rein, of Jena. She has undertaken the task of transplanting the methods and principles of Herbartian pedagogy into the elementary schools of England. A summary of the general principles of education, and the Herbartian doctrine of interest and instruction furnish the English readers with the fundamental conceptions of education as seen in the writings of Herbart and his followers. A good description is given of the course of instruction followed in the culture-epoch schools of Germany. The most interesting feature of this work is the attempt to adopt these culture-epochs to the needs of children of the English race. The legends and history of Germany are changed for those of England. Miss Dodd closes this interesting work with a brief history of the rise and development of the Herbartian movement in Germany.

The Nature and Development of Animal Intelligence, by WESLEY MILLS, M. A., M. D., D. V. S., F. R. S. C. Macmillan, N. Y., 1898. pp. 307.

At last we have these very careful and objective studies that have appeared in a fragmentary way in many forms and places, put together into a more or less systematic whole. Part I is occupied with describing animal intelligence and comparative psychology; Part II deals with squirrels, with special reference to feigning, and to hibernation. Part III treats the psychic development of young animals and its physical conditions, brain growth and its relation to psychic development; and part IV represents various discussions. The work is of great acumen, and a very valuable addition to the literature of the subject, but is handicapped by a title too large for it. The author's strong point is fidelity and patience of observation and description rather than generalization or discussion. The book is so diversified that it needs the admirable index which it has.

Die Masturbation, von Dr. H. ROHLER. Berlin, 1898. pp. 319.

This "monograph for physicians and pedagogues" is written in conformity to the motto that the "diseases of society can be no more

cured than can those of the body without speaking of them openly and freely." The work is elaborate and systematic, discussing literature, definitions, history, forms, diffusion, onanism among animals, etc. The causes are divided as those lying in the body, as laziness, moral weakness, over liveliness, precocity, bodily defect, etc.; and those out of the body like education at home and in school, faulty dress, food, abnormal fear, unwholesome occupation. The results are specified for nerves, senses, digestion, muscles, respiration, cerebellum, etc., and therapeutics occupy most of the last hundred pages.

Ueber die Sexuellen Ursachen der Neurasthenie u. Angstneurose, von DR. FELIX GATTEL. Berlin, 1898. pp. 68.

The author, a nerve specialist in Berlin, has evidently been profoundly influenced by Kraus, Hecker, and Brener, and Freud's recent brilliant studies on hysteria, and depends on the basis of 100 sexual cases in the clinique of Krafft-Ebing. The general thesis is that the neurosis of onanists always occurs where there is a restraint of the sexual desire, and full neurasthenia can arise only as a result of masturbation.

Arbeit und Rhythmus, by M. K. BÜCHER. Allg. Phil. Hist. Classe Sächs Ges. der Wiss., Bd. 17, No. 5. Leipzig, 1896.

This important and fascinating monograph shows by many illustrations how half civilized people are prone to work rhythmically and even in concert and to sing. Work is thus argued to be the cause of song and poesy, dance and the drama. This conclusion is illustrated by hypothetical stages of development of lyric and epic poetry. Rhythm is potent as a means of unifying work and creating voluntary communities of laborers. Machinery has weakened and in many cases threatens the decay of the rhythmic impulse. If it goes, the superstructure of music will also be endangered.

W. V. Her Book and Various Verses, by WILLIAM CANTON. Stone and Kimball, N. Y., 1898. pp. 146.

This very tasteful little book is made up of prose records of very cute doings, and especially sayings of the heroine, *V. G.* The bushes have their hands full of flowers; the buds are the trees' little girls; Jesus is cleverer than we are; did the church people put Jesus on a cross? her new words, fussle, sorefully, sickly, etc., are stated in prose, and the author then lapses into brief versicles describing the incidents poetically.

A Study of a Child, by LOUISE E. HOGAN. Harper's, N. Y., 1898. pp. 220.

This attractively printed and bound book is illustrated by over 500 drawings by the child. There are eight chapters, the first representing the first year of Harold's life, and so on to the eighth. Following the chronological order the author finds it unnecessary to observe any other, and there is no index to aid the reader. The first year notes are particularly fragmentary, and are only seven pages. Many of the notes are interesting and suggestive, and many are very inane. There are almost no attempts to draw conclusions of any sort, but only objective accounts of specific things the child did and said.

The Development of the Child, by NATHAN OPPENHEIM. Macmillan Co., N. Y., 1898. pp. 296.

The author is the attending physician to the children's department of Mt. Sinai Hospital Dispensary in New York city, whose supplementary culture enables him to discuss in an interesting way the

relation of heredity and environment; the place of the primary school and of religion in a child's development; the value of child testimony; the evolution of the juvenile criminal; the bearings of the mode of development as productive of genius or defect, institutional life and the profession of maternity. The book is on a far higher plane than such works of Taylor and Hogan noticed in this number, but is suggestive rather than conclusive, indicating a certain immaturity of view, and frequently a disposition to expatiate in what are almost the commonplaces of the subject. Still it is a book to be heartily commended to parents.

Psychologie de l'Instinct Sexuel, par DR. JOANNY ROUX. Paris, 1899. pp. 96.

This is an admirable little compend of the subject. Starting with a résumé of the leading current conclusions of biology on the subject, the author passes to the discussion of the general theory of fecundation and thence of love. Its merit consists in the author's wide acquaintance with recent scientific literature in the various fields, and in his lucidity and conciseness of statement.

Citizenship and Salvation, or Greek and Jew, by A. H. LLOYD, Ph. D., Assistant Professor of Philosophy, University of Michigan. Little, Brown and Co., Boston, 1897. pp. 142.

In Part I the author describes the death of Socrates and its influence on Greek thought, and then on Roman. In Part II he describes and discusses the death of Christ in Judea and the fall of Rome. Part III is devoted to an account of the resurrection or the Christian state.

The Study of the Child, by A. R. TAYLOR, M. D., President of the State Normal School of Emporia, Kansas. D. Appleton and Co., N. Y., 1898. pp. 215.

This book is Volume XLIII in Dr. Harris's Educational Series, and makes an attempt to study and present the results of the study of children. It claims no originality, but only to fit the reader to enter upon the study of children. It treats the senses, consciousness, apperception, attention, symbolism, sayings, feelings, will, intellect, concepts, self, habit, character, manners and morals, normal and abnormal. It seems to the writer of this note that the title might, with minor modification, just as well have been the study of the adult, or psychology, according to Froebel, Herbart and Harris. The book is abstract, and contains almost nothing genetic and little that is concrete; but is a restatement of stock matter in the general field of mental philosophy with such adjustments as show that from that standpoint child study has a place, and this is something to be grateful for.

Versuch einer Darstellung der Empfindungen, von WALTER PRIZBRAM. A. Hölder, Wien, 1898. pp. 28.

This posthumous work, edited by the author's brother, attempts "to bring sensations as immediately given purely psychic facts into a mathematical system, the formulas of which shall be a complete description of single sensations in general, and discussable under the special cases." It is impossible to describe the system in brief form. Five large tables present the chief terms and forms used.

Essai sur la Classification des Sciences, par EDMOND GOBLOT. F. Alcan, Paris, 1898. pp. 296.

The first chapter discusses the formal unity of sciences, logical dualism, and the common laws of the development of all sciences, viz.,

induction, mathematics, and deduction in the sciences of nature. The main body of the book is an exposition of the system of sciences which falls into the following order: Arithmetic, algebra, geometry, mechanics, including cinematics and dynamics, cosmology, biology, psychology and sociology, including æsthetics and morals. Other sciences are sub-sections of these.

L'Illusion de Fausse Reconnaissance, by E. BERNARD-LEROY. Paris, 1898. pp. 249.

The author sent out a long questionnaire to educated people requesting accounts of striking experience of having been in a new place. Of his returns he selects and prints in full 86, which make the last 150 pages of his book, the first being devoted to discussions. Rejecting Ribot's theory that there are two successive and perfectly conscious impressions, the first real and the second hallucinatory, he holds recognition to be a unique kind of "intellectual sentiment" associated with re-known phenomena. The manifestations of this sentiment may become almost chronic. It is not necessary to assume a difference between sensation and perception, or between impersonal impressions and those where the subject is conscious.

Classified Reading, by ISABEL LAWRENCE. Published by the author, St. Cloud, Minn., 1898. pp. 423.

This is a descriptive list of books for school, library and home. Pedagogy, child study, geography, history, English, and miscellaneous, the latter including manual training, drawing, physical culture and music, are the chief topics. There are wide margins for additional literature. It is easy to find fault with every such book both for what it includes and excludes, but on the whole this can be most heartily commended to every teacher or student of geography, history or English, as a very valuable companion and helper in their work.

Ignorance, by M. R. P. DORMAN. London, 1898. pp. 328.

The author undertakes to study the causes and effects of ignorance in popular thought and to make educational suggestions. No one before has attempted to reduce ignorance to a science. Its effect is traced on art, letters, capital, economy, state, woman, and collective and individual ignorance are distinguished. The author emphasizes unconscious causes and cures. Large ideas in small minds, the retirement of the fittest, new superstitions of ultra idealism, ultra spiritualism, uncritical orthodoxy, the substitution of feeling for the ease with which women conceal ignorance by following custom, the degradation of the pulpit, press, stage, methods of advertisement, etc., are among the causes of ignorance to be contended against.

The Elements of Physical Education, by D. LEMOX, M. D., and A. STURROCK. Blackwood, London, 1898. pp. 241.

This is a teacher's manual copiously illustrated with 147 cuts of children practicing free gymnastics and using ball, wand, dumb-bells; and some 40 pages of new gymnastic music, by H. E. Loseby. The first 67 pages are taken up with very elementary anatomy and physiology. It is a practical and interesting book.

A Course of Practical Lessons in Hand and Eye Training for Students, 1-4, by A. W. BEVIS. London, 1898.

These are four handbooks of some 150 pages each, illustrating a new course of work adopted by the Birmingham English School Board, and are full of new and suggestive work.

The Play of Animals, by KARL GROOS. Tr. by Elizabeth L. Baldwin. Appleton & Co., New York, 1898. pp. 341.

It was a happy idea to translate this valuable book from the German, and Miss. Baldwin has done her task very acceptably. Professor Baldwin writes a characteristic preface of eleven pages, and a reprinted appendix of four pages quoting from himself, or referring to his work some fourteen times, claiming four out of nine factors of organic evolution, and offering a series of criticism, "even though to a thinker like Professor Groos they may be trivial and easily answered." On the whole the work of Groos is commended, but were not most of its best ideas either hinted at or better expressed, or were not most of the facts more truly stated by Professor Baldwin at some distinctly previous date?

CORRESPONDENCE.

Dr. Herman T. Lukens has written the following personal letter to the editor. It was with no thought of publication, but Dr. Lukens has kindly consented to let it appear in the *Journal*, without change :

My Dear Sir :

I have just been out to Chevy Chase to see Dr. Elmer Gates and his laboratory. The work on enlargement of the laboratory is still under way, so that I did not see things and apparatus in working order, but in heaps. He has raised the old building one story, and built a new first story. It is a fine situation on the same lot with his residence, with ground enough around for two or three new buildings besides a fine lawn. The property is his own, laboratory and all, but he has received donations of various amounts (I think he said \$320,000) from Mrs. Phebe Hurst and others to aid in special investigations. His work covers the whole range of the sciences. He has just invented a way of getting an electric current from the action of sunlight without the intervention of dynamo or engine. He started in on the study of looms some time ago, and in nine months had sixty-eight new inventions of improvements in the loom ; one of these inventions he disposed of for ten per cent. royalty, receiving \$62,000, with which he is building his new laboratory now. He employs a force of trained assistants, machinists, etc. His metallurgical room is for investigations in alloys. He proposes to make a complete series of 10,000 (or so) varying percentages of alloys of certain two metals, and test the properties of the alloys. He is at present on optics and acoustics. He proposes to put up a building in which will be museum, laboratory and all apparatus needed to demonstrate every known fact about sight or sound. Then he will take a class through by his method of work, which goes by regular stages: (1) Sensations, (2) Images, (3) Concepts, (4) Ideas, (5) Thoughts, 1st order, (6) Thoughts, 2nd order, (7) Thoughts, 3rd order. He aims to get as many different sensations as possible. Out of these come images of objects. These are grouped by likeness into concepts. Then the concepts are each to be related to every other one. He keeps going over and over the material trying to find relation of concepts systematically, *i. e.*, of every possible pair. He lays much stress upon this mechanical completeness of the system. He goes to bed at 8.30 and gets up at 5.30, works till 1 or 2, and gives afternoon to social life and relaxation.

He and his wife began to prepare themselves for parenthood a year or two before they created their last child. They avoided all onesided specialism and aimed to develop all the good emotions and exercise their minds on the whole round of human knowledge. During pregnancy his wife avoided all evil passions, anger, envy, etc., and cultivated good emotions, social and altruistic instincts, art, literature, dramas, the sublime in nature, heavens, the spirit of the cosmos, etc. The child was born at full time, without any pain, and the whole process of birth took only two and one-half hours. He has two bright children, on whom he has been trying various new ideas. The oldest at 21 months, he says, knew 11,000 words.

He is at work on sexual perversion, invisible rays of the spectrum,

conditions of work, etc. He has records for twenty years of his own activity and environment, atmospheric potential, electrical potential, barometer, wind, etc. He has an army of readers working for him in the gigantic task of sifting facts out of scientific books. He is trying to get all the alleged facts collected, and then test these and weed out the theories and mere "accepts," thus reducing the great mass of rubbish to a small compass of accessible facts,—a scientific Bible, as he says; for what is more sacred than truth, and what more satanic than falsehood? He showed me a great mass of manuscript material,—an attempt to work over the Standard Dictionary and extract the words that stand for new ideas in sound and light. These are on catalogue cards for purposes of classification, and filled several large drawers.

He has a great mass of notes that have been collecting for 20 years, and which he proposes to begin to edit in a series of books which will bring out his ideas better than anything else he has thus far done. These will include best regimen for work, scientific rearing of children, method of invention, encyclopædic Bible of science, etc.

Dr. Gates has a lovely home, into which he has put a large part of himself. It shows the man of ideas and of resources. He is affable and cordial, gave me unstintingly of his time and attention, and spoke freely of everything. He seems to me to have made a great mistake in not publishing, so as to get the criticism of fellow workers and the steadying influence of co-operation in investigations. But he is sincere, has the scientific spirit, and is a man of original ideas who will be more and more known as the years go by.

NOTES AND NEWS.

DR. WRESCHNER'S WEIGHT EXPERIMENTS.

In my review of Dr. Wreschner's *Beiträge zu psychophysischen Messungen* (this *Journal*, IX, 591 ff.), I noted the fact that the author nowhere states whether his subjects were informed of the time-order of the experimental series. "Were the subjects told the time-order of the first double series or not? Presumably not, since the procedure at large was procedure without knowledge. . . . The knot is cut if the subjects were acquainted with the time-order in every case; but this is nowhere stated." (P. 593.)

Dr. Wreschner has requested me to give publicity to the following statement: "The subjects were always told beforehand whether a P I or a P II series was coming. The method was only so far without knowledge that the magnitude of the weight of comparison was unknown to the subjects in each experiment. I regret that I did not expressly say this in the chapter 'Das Versuchsverfahren;' but a remark upon the matter occurs on p. 210 (2 lines from the top)."

I am very glad to call attention to this correction, which is of great importance for any estimate of Dr. Wreschner's theory of the time-error. I may add that the sentence on p. 210 was one of the two or three puzzling passages that led me to note the omission pointed out in my review.

E. B. T.

EXPERIMENTAL PSYCHOLOGY IN ENGLAND.

During the absence of Dr. W. H. Rivers with the Borneo Expedition, the courses in Experimental Psychology at University College, London, are given by Mr. E. T. Dixon, known by his mathematical publications in the *Proceedings* of the Aristotelian Society, and by his work on visual space recently published in *Mind*.

THE WELBY PRIZE.

The Welby Prize of £50, offered for the best essay on the subject of "The Reasons for the Present Obscurity and Confusion in Psychological and Philosophical Terminology, and the Directions in which we may look for Efficient Practical Remedy," has been awarded to Dr. Ferdinand Tönnies, of Hamburg. A translation of the successful essay will shortly appear in *Mind*.

UNIVERSITY NEWS.

Mr. Henry Wilde, F. R. S., of Manchester, has endowed in the University of Oxford a Wilde Readership and a John Locke Scholarship in Mental Philosophy.

Dr. R. Macdougall has been appointed assistant director of the Psychological Laboratory in Harvard University; Dr. F. G. Lancaster, professor of Psychology and Pedagogy at Colorado College; Dr. C. H. Judd, professor of Experimental and Physiological Psychology in the School of Pedagogy, New York University; Dr. D. S. Miller, lecturer in Psychology at Columbia University; Dr. E. Thorndike, instructor in Psychology at the Western Reserve University; Mr. G. M. Whip-

ple, assistant, and Dr. I. M. Bentley, instructor in Psychology at Cornell University; Dr. E. A. Gamble, instructor in Psychology, Wellesley College.

In accordance with the request of the Government of Venezuela, and of the Committee on Organization, the III Pan American Medical Congress has been postponed to meet in Caracas in December, 1900.

FORTHCOMING BOOKS.

The following books on psychological subjects are announced as in preparation:

Baillière, Tindall & Cox: "Aids to Psychological Medicine," by T. A. BEADLE; "Handbook for Attendants on the Insane," by authority of the Medico-Psychological Association.

Cambridge University Press: "An Introduction to Psychology," by G. F. SROUT and J. ADAMS.

J. & A. Churchill: "Clinical Lectures on Mental Diseases" (CLOUSTON), with new plates.

C. Griffin & Co.: "Mental Diseases," by W. B. LEWIS.

Longmans & Co.: "Psychology in the Schoolroom," by T. F. G. DEXTER and A. H. GARLICK.

The Macmillan Co.: "First Experiments in Psychology, an Elementary Manual of Laboratory Practice," by E. B. TITCHENER.

Scientific Press, Ltd.: "Medical Aspects of Education," by P. G. LEWIS; "Mental Nursing," by W. HARDING.

W. Scott, Ltd.: "Degeneracy," by E. S. TALBOT.

Swan Sonnenschein & Co.: "Aristotle's Psychology," by W. A. HAMMOND; Wundt's "Physiological Psychology," trs. by E. B. TITCHENER.

University Correspondence College Press: "Manual of Psychology," by G. F. SROUT.

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HYDRO-PSYCHOSES.

By FREDERICK E. BOLTON, Late Fellow in Psychology, Clark University.

In this study we wish to investigate the influence that water has exerted in shaping and moulding man's psychic organism. The thoughts expressed in literature have been greatly influenced by pelagic conditions. Not only are there accounts of water spirits, nautical tales, etc., but almost every page bears evidence through metaphor of the modifications of thought and expression by water. Note the phrases "stemming the tide," "current of thought," "flowing robes," "torrents of joy," "a total wreck," "drown grief," "sinking in adversity," "ebbing life," etc. The poets have been especially inspired by the sea, the brook, the rill, etc. Many of the poems relating to water have been set to music, and have played a great rôle in religious worship. Hymnology is replete with allusions to water. What is now poetical allusion was in primitive times the expressions of belief. The poetry of to-day was the philosophy of yesterday. So, too, mythology chronicles as mere tales former firm beliefs. In this we find abundant evidence of the great influence water exerted upon savage peoples. Nearly all primitive peoples had their water spirits, and even the rivers and seas were supposed to be alive. The literature of all nations abounds with tales of fountains of youth, rivers of life, etc. Omens, superstitions, sayings relating to water and to water gods are numerous. Philosophy, religion, medicine, mythology, have all been influenced by various ideas concerning water.

Besides the foregoing, all people have feelings about water which are only partially explainable by present relations and circumstances. Much may be explained by the vastness, the activity, the feeling of, individual experiences, etc., but there

is still a residuum wholly unaccounted for by individual experiences and by the phenomena themselves. Apparently, only the psychic history of the race can offer adequate explanations. If the causes do not not appear in the phenomena, the cause must be in the soul itself. The soul in its long period of development must have passed through experiences, the present manifestations of which are but reverberations of a remote psychic past. To trace the genesis of these conceptions and feelings and to study the reaction of people, both in the past and in the present, toward this phase of nature is the object of this investigation.

EVIDENCES OF MAN'S PELAGIC ANCESTRY.

There are several lines of argument which give such abundant proofs of man's pelagic ancestry that little doubt of it remains in the minds of scientists. Chief among these on the physical side are the proofs afforded by Embryology, Morphology, Paleontology and Pathology. Recent valuable additions have been made by a study of survival movements. By showing transitory characteristics in process, much may be gleaned indirectly from a study of these groups of animals which were once land animals, but which have returned to the sea.

Each of these classes of evidence, with the exception of that drawn from Paleontology, will be passed in review.

Embryological, ua. General. Man, like all other animals, begins life as a unicellular organism. The earliest stages of development which the human embryo passes through, so far as is known, resemble those of all other animals. The only difference between the development of the human embryo and the embryo of other animals is that the human embryo goes away beyond all other organisms in its unfoldment. But so close are the resemblances among the earliest embryonic stages that differences are unrecognizable. Some one has said, James, I think, that for some time no human being can determine whether a given embryo will turn out a frog or a philosopher. Romanes says¹ that when man's "animality becomes established, he exhibits the fundamental anatomical qualities which characterize such lowly animals as polyps and jelly-fish. And even when he is marked off as a Vertebrate, it cannot be said whether he is to be a fish, reptile, a bird or a beast. Later it becomes evident that he is to be a Mammal, but not till later still can it be said to which order of mammals he belongs."

Not only do the embryonic forms of all vertebrate animals, resemble each other in their general characteristics, but special organs or systems of the higher mammals, can be traced out in

¹ Darwin and after Darwin, I, 119.

the various stages of development. It is well known that resemblances of the mammalian embryos to lower vertebrates flash out as each new step is attained. As Prof. Drummond has put it we have "first the resemblance of the Fish, then of the Amphibian, then of the Reptile, lastly of the Mammal."¹

b. Nervous System. Considering the development of the central nervous system we find that different stages of the human embryonic brain have close homologies in some of the great groups of lower animals. Man's brain passes through a series of stages of increasing complexity. These stages are only temporary in the human embryo, while they represent the maximum development of the group corresponding to each stage. Prof. H. DeVarigny says: "One may easily detect in the evolution of the human brain a stage corresponding to that of the brain of fishes; but while the fishes permanently retain this brain-structure, an advance occurs in man, and the brain acquires characters of the reptilian encephalon; later on it progresses again, and acquires bird characters, and finally it acquires those characters which are peculiar to mankind. Here again, ontogeny demonstrates phylogeny."²

c. Circulation and Respiration. Romanes sums up what Darwin and others had first pointed out concerning the development of the foetal circulatory and respiratory organs by saying that, "at the time when the gill-slits and the gill-arches are developed in the embryonic young of air-breathing Vertebrates, the heart is constructed upon the fish-like type. That is to say, it is placed far forwards, and from having been a simple tube as in the worms, is now divided into two chambers, as in Fish. Later it becomes progressively pushed further back between the developing lungs, while it progressively acquires the three cavities distinctive of Amphibia, and finally the four cavities belonging only to the complete double circulation of Mammals. Moreover, it has now been satisfactorily shown that the lungs of air-breathing Vertebrata, which are thus destined to supersede the function of gills, are themselves the modified swim-bladders³ or float which belong to Fish. Consequently all these progressive modifications in the important organs of circulation and respiration in the air-breathing Vertebrata, together make up as complete a history of their aquatic pedigree as it would be possible for the most exacting critic to require."⁴

Rudimentary Organs. In almost all animals and plants we find rudimentary or vestigial organs which serve no purpose in

¹ The Ascent of Man, p. 72.

² Prof. Henry DeVarigny: *Experimental Evolution*, p. 35.

³ See Darwin: *Descent of Man*, pp. 160-61.

⁴ Romanes' Darwin and after Darwin, I, 154.

the present life of the organism. Some of these appear only in the embryo, then become absorbed or pass away, leaving little or no trace of their presence. Everybody knows of the gills, tail, and swimming apparatus which frogs and toads possess during the tadpole stage, and which remain in adult life only as vestigial structures. There is a species of salamander (*salamander atra*) which lives high up among the mountains, brings forth its young full formed like the mammals, but whose tadpoles, or young, possess exquisitely feathered gill-slits. If the young chance to be removed from the body of the mother before the close of the normal period of gestation, the young salamanders will swim away like fish if placed in water. When born at full term they will drown as will the adult animal if placed in water. These organs, adapted to aquatic life, and which have "reference to ancestral adaptations, repeat a phase in the development of its progenitors."¹

The life history of individuals cannot in every case, of course, present a full and complete recapitulation of its ancestors. To preserve all useless structures would be a waste of energy and material, and nature is never prodigal. The law of use and disuse are ever operative. As soon as structures lose their functions they tend gradually to disappear. If detrimental they are the sooner dropped off.² The vestigial or obsolescent structures which come regularly under our notice in any class of individuals are undoubtedly those which subserve some unknown purpose during embryonic life, or they are such as have only recently ceased to function. Those that appear occasionally, but are absent in the normal individuals, are probably the reverberations of long-since abandoned organs, but have become reawakened through stimulations that have called forth functions similar to those possessed by the organ in question, or they may belong to arrested development. To this class many pathological freaks and abnormalities may undoubtedly be referred. Romanes says that "the foreshortening of developmental history which takes place in the individual lifetime may be expected to take place, not only in the way of condensation, but also in the way of excision. May pages of ancestral history may be recapitulated in the paragraphs of embryonic development, while others may not be so much as mentioned."³

Vestigial Structures in Man. In the human body there are numerous obsolescent organs, which persevere in form only, and give unequivocal evidence of former ancestry. There are in all upwards of 130 that have been discovered. The vermi-

¹ G. H. Lewes, in Darwin's Origin of Species, p. 398.

² Romanes' Darwin and after Darwin, I, 103.

³ Darwin and after Darwin, I, pp. 103-4.

form appendix is one of the best known. It is as fully developed during foetal life as in adult. The muscles by means of which the external ear is moved is demonstrable only in exceptionally atavistic individuals. The *panicules carnosae*, or muscles by means of which animals move the skin, still exhibit vestiges of former function in man. Club-feet are said to be atavistic reminiscences of remote ancestors, meaning no more nor less than baboon feet.¹

"Prominent among these vestigial structures are those which smack of the sea. If embryology is any guide to the past, nothing is more certain than that the ancient progenitors of Man once lived an aquatic life. At one time there was nothing else in the world but water-life; all the land animals are late inventions."² After emerging from the annelide and molluscan stages, what was to become man remained in the water until evolution had produced a fish-like stage; "after an amphibian interlude he finally left" the watery domain, but "many ancient and fish-like characters remained in his body to tell the tale."³

One typical vestigial structure which dates back to sea ancestry is the *plica semi-lunaris* or the remnants of the nictitating membrane of fishes. It is a semi-transparent curtain-like membrane formed on the inner side of the eye as a vertical fold of the conjunctiva,⁴ which apparently is of great utility in sweeping across the eye to cleanse it. It is very common among birds, some fishes, reptiles, and amphibians,⁵ and most vertebrates.⁶ In man only a small fold or curtain draped across one side of the eye, and Romanes states that it is rudimentary only in animals above fishes.⁷

The most unequivocal rudimentary structures which give indication of water ancestry are the visceral clefts, or gill-clefts, in the neck-region. These were the first discovered vestigial structures to indicate the probable line of descent. These structures are first seen in the amphioxus, the connecting link between invertebrates and vertebrates. "In all water-inhabiting Vertebrates which breathe by means of gills the thin epithelial closing plates break through between the visceral arches, and indeed in the same sequence as that in which they arose. Currents of water, therefore, can now pass from the outside through the open clefts into the cavity of the fore gut, and

¹ Drummond : Ascent of Man, p. 96.

² Drummond : The Ascent of Man, p. 83.

³ *Loc. cit.*, p. 85.

⁴ Text-book of Embryology, Hertwig-Mark, p. 487.

⁵ Darwin : Descent of Man, p. 17.

⁶ Hertwig-Mark : A Text-book of Embryology, p. 487.

Darwin and after Darwin, I, 74.

be employed for respiration, since they flow over the surface of the mucous membrane. There is now developed in the mucous membrane, upon both sides of the visceral clefts, a *superficial, close, network* of blood-capillaries, the contents of which effect an exchange of gases with the passing water. Likewise in the case of the higher (amniotic) vertebrates,¹ both inner and outer visceral furrows, together with the visceral arches separating them, are formed; but here they are never developed into an actually functioning respiratory apparatus; they belong, consequently, in the category of rudimentary organs. Upon the mucous membrane arise no branchial leaflets; indeed the formation of open clefts is not always and everywhere achieved, since the thin epithelial closing membranes between the separate visceral arches are preserved at the bottom of the externally visible furrows."

The number of gill-clefts and visceral arches decreases in the ascending scale of vertebrate life. In some of the lower species, as the selachians, there are seven or eight, while birds, mammals and man, possess but four.² The number of external openings, also, is found to constantly decrease as we ascend the scale of life. In the higher mammals and man they would scarcely be known were it not for their detection in the embryonic stage. But they are discernible in the chick embryo on the third day of incubation, and they may be seen distinctly in the human embryo according to His when the embryo has attained a length of three or four millimeters. They begin to become obliterated by the fourth week of foetal life.³ But still says Drummond "so persistent are these characteristics [gill-slits] that children are known to have been born with them not only externally visible—which is a common occurrence—but open through and through, so that fluids taken in at the mouth could pass through and trickle out at the neck. . . . Dr. Sutton has recently (*Evolution and Disease*, p. 81) met with actual cases where this has occurred. . . . In the common cases of children born with these vestiges the old gill-slits are represented by small openings in the sides of the neck, and capable of admitting a thin probe. Sometimes, even, the place where they have been in childhood is marked throughout life by small round patches of white skin."⁴ Dr. Hertwig also mentions the fact that fistulæ, which penetrate from without inward for variable distances, sometimes even opening into the pharyngeal cavity, are to be met with in human beings.

¹ Text-book of Embryology, Hertwig-Mark, pp. 286-7.

² *Ibid.*, p. 287.

³ Hertwig-Mark: Text-book of Embryology, pp. 288-9.

⁴ Drummond: Ascent of Man, p. 81.

These are explainable as being still open clefts of the cervical sinus.¹

The ultimate metamorphosis of the embryonic gill-clefts is still a question of much interest. There is little doubt but that the thymus and probably the thyroid gland are derived from the visceral clefts.² The thymus is derived, according to Kölliker, Born and Rabl, from the third visceral cleft. Some authorities, among them De Meuron and His, differ in minor points, principally as to the number of clefts involved,³ but in the main they agree. The thymus is found in all animals, beginning with the fishes. Even in the fishes it is derived from epithelial tracts of the open gill-clefts still functionally active. Dohrn holds that the thyroid gland is the remnant of ancient gill-clefts of the vertebrates. Although this is disputed by Hertwig he still admits that "it appears to be an organ of very ancient origin, which shows relationship to the hypobranchial furrow of *Amphioxus* and the Tunicates."⁴ It, at any rate, gives strong evidence of the close relationship, being developed "from an unpaired and a paired evagination of the pharyngeal epithelium,"⁵ and in the region of the former visceral clefts, and by good authorities it is claimed to be developed from them. The so-called accessory thyroid gland is conceded by all to have thus arisen. The unpaired fundaments which contribute toward the thyroid are not wanting in a single class of vertebrates.⁶ Dohrn makes several bolder hypotheses concerning the metamorphosed products of the embryonic clefts. He maintains (1) "that the mouth has arisen by the fusion of a pair of visceral clefts, (2) that the olfactory organs are to be referred to the metamorphosis of another pair of clefts, a view which is also shared by M. Marshall and others, (3) that a disappearance of gill-clefts in the region of the sockets of the eye is to be assumed, and that the eye-muscles are to be interpreted as remnants of gill-muscles."⁷ Hertwig, however, dissents from some of these views. But, most embryologists are agreed that the middle and outer ear are derived from the upper portion of the first visceral cleft and its surroundings. In fishes there is no external auditory apparatus, and these organs, which in man develop into an ear, subserve another purpose. The Eustachian tube represents a partial closure of an original cleft; the tympanic membrane is devel-

¹ Hertwig-Mark: Text-book of Embryology, p. 290.

² *Ibid.*, p. 316.

³ *Ibid.*, p. 316.

⁴ Hertwig-Mark: Text-book of Embryology, p. 317.

⁵ *Loc. cit.*

⁶ *Loc. cit.*

⁷ Hertwig-Mark: Text-book of Embryology, p. 288.

oped from the closing plate of the first visceral cleft and surrounding portions of the arches ; and the external ear is derived from the ridge-like margins of the first and second visceral arches.¹

"Ears are actually sometimes found bursting out in human beings half way down the neck in the exact position—namely, along the line of the anterior border of the sterno-mastoid muscle—which the gill-slits would occupy if they still persisted. In some families, where the tendency to retain these spacial structures is strong, one member sometimes illustrates the abnormality by possessing the clefts alone, another has the cervical ear, while a third has both the cleft and a neck ear—all these, of course, in addition to the ordinary neck ears."²

Survival Movements. An exceedingly interesting and important study, and one which sheds much light upon the present problem, was carried out by Dr. Alfred A. Mumford, of England.³ He noticed the peculiar paddling or swimming movements which a young babe, a few days old, made when it was placed face downwards with only hands and feet touching the floor, its head and abdomen being supported by a hand placed under each. Being struck with the great similarity of these movements to those made in propulsion through a watery medium he began a systematic study of infants' movements. Besides confirming and extending many of the recent observations concerning an anthropoid relationship he makes statements which are much more far-reaching.

He has noted that the position of the limbs at birth and during the first few weeks of infancy tend to assume the primitive developmental position, viz.: "folded across the chest, thumb towards the head, and with the palm towards the thorax ; but more often the palm is away from the chest-wall, and is directed anteriorly by means of extreme pronation, the dorsum of the hand often lying on or near the shoulder, sometimes an inch or two outside. As the child wakes up the elbows begin to open out and the palm is pushed outwards in a way that would be useful in locomotion, especially in a fluid medium. In fact it is the movement of the paddle." These movements are described as slow rhythmical movements of flexion and extension, such as one sees among animals in an aquarium. They occur often in series of three at a time during a quarter of a minute, followed by alternating pauses. These are interpreted as vestigial movements of a former amphibian existence, which were of fundamental importance before forelimbs developed.

¹ *Ibid.*, pp. 505, 511.

² Drummond : *Ascent of Man*, p. 89.

³ Brain, 1897.

This is supported by the shape of the hand, which is one of the most highly developed of bodily organs in function, but in some respects least modified of all the skeleton. "In shape and bones it is more like the primitive amphibian paddle than is the limb of any other mammal."

We also know that there are many reflex movements known as vibratory or oscillatory, which are especially common among children, though by no means confined to them. Among them are those of tapping, swaying, and others of a rhythmical nature.¹ Swaying from side to side is very noticeable in small school-children. They sway from side to side and forward and backward. Fish swim, in part, by similar movements, and in view of man's pelagic line of ascent, it is not improbable to suppose that swaying and possibly other reflex rhythmic and oscillatory movements may be recrudescences of former aquatic life. That they are atavisms, seems borne out by the fact that intellectual fatigue increases such automatisms.² That is, fatigue causes a temporary relaxation of the control exercised by the higher and more recently developed psychic centers and a reversion toward more primitive conditions. It is probable that all automatic movements, as well as expressive movements, are weakened repetitions of movements that were once of utility.³

ORIGIN OF ANIMAL LIFE.

Not only have speculative philosophy and mythology claimed for everything a sea origin [see later sections in this paper] but science has actually demonstrated that the beginning of life was in the sea—near the bottom. This is as true of vertebrate as well as of invertebrate life.⁴ Dr. Brooks writes: "We may feel sure even in the absence of sufficient evidence to trace their direct paths, that all the great groups of Metazoa ran back to minute pelagic ancestors."⁵ Another authority writes that "for the present we may conclude that the proximate ancestor of the vertebrates was a free-swimming animal intermediate in organization between an ascidian tadpole and amphioxus." The same writer claims that the ultimate or primordial ancestor

¹ See Dr. T. L. Bolton's article on Rhythm, *Am. Jour. of Psych.*, Vol. VI, p. 145.

² Lindley: Motor Phenomena of Mental Effort, *Am. Jour. of Psych.*, Vol. VII, p. 506.

³ See Lindley, *loc. cit.*

⁴ W. K. Brooks: The Genus Salpa Mem. Biol. Lab., Johns Hopkins Univ., p. 153.

⁵ W. K. Brooks: The Genus Salpa, p. 159; see also p. 163.

of the vertebrates was a worm-like animal with an organization approximating the bilateral ancestors of the echinoderms.¹

Science has also shown us that a great body of animals have been gradually crawling out of the sea. "From almost every country pond, or ditch, or swamp," says Miss Buckley, "a chorus of voices rises up in the spring-time of the year, calling to us to come and learn how Life has taught her children to pass from the water into the air; for it is then that the frogs lay their eggs, and every tadpole which grows up into a frog carries us through the wonderful history of animals beginning life as a fish in water with water-breathing gills, and ending it as a four-legged animal with air-breathing lungs."²

All the amphibians, or double-lived animals, are just emerging from the water. We find them in all stages of transition, some having only just begun to emerge, while in others the transition is so nearly complete that their former identity is scarcely discernible.³

But the young of all amphibians begin life in an aqueous medium, thus recapitulating, as all animals do, the life of the race. In embryonic, or tadpole life, all amphibians possess gills for extracting oxygen from the water, and organs for water locomotion. It is only when they reach an adult stage that they possess organs which equip them for terrestrial existence.

ANIMAL RETROGRESSIONS TO AQUATIC LIFE.

But there have been many retrogressions in the process. Many animals after rising step by step above the fishes, and through the backboned animals until they reached a rank only a little below the primates, for some reason have gone back to the sea. The French song says "on revient toujours à ses premiers amours." Among those that have completely forsaken the land and assumed fish-like characters such as to almost elude detection are the whales, porpoises, and dolphins. Their fish-like forms and marine habits seem to indicate affinities with the fishes. But their internal structure, breathing, and mode of reproduction and suckling the young proclaim their mammalian kinship. They resemble quadrupeds in their internal structure, and in some of their appetites and affections. Like quadrupeds they have lungs, a midriff, a stomach, intestines, liver, spleen and bladder. The organs of generation and heart are quadrupedal in structure. "The rudimentary teeth of the whalebone-whales, which never come into use, are final

¹ Arthur Willey: *Amphioxus and the Ancestry of the Vertebrates*, p. 291.

² Arabella Buckley: *Winners in Life's Race*, p. 71.

³ Dr. W. K. Brooks: *The Genus Salpa*, *Memoirs fr. the Biol. Lab., Johns Hopkins Univ.*

links in the chain of evidence." says Professor Oskar Schmidt,¹ "that the whalebone-whales are the last members of a transformed group which commenced with animals with four toes and numerous teeth, and which, by the gradual diminution of the dentition, have become whalebone-whales." The fins still retain the bones of the shoulder, forearm, wrist and fingers, though they are all enclosed in a sac and could render no service except in swimming. The head is also mammalian save in shape, which has become modified and fish-shaped for easier propulsion in the water. The mammalian skull with all the bones in their proper anatomical relations to one another are still preserved.² Prof. Schmidt says in regard to the dolphin that the "hind limbs, like those of the Sirenians, have disappeared externally without leaving a trace of their former existence; the rudimentary pelvic bones that are concealed in the flesh—sometimes with the last remnant of the thigh bone, very rarely with the shank—bear witness, however, to their having possessed ancestors with four legs."³

There are several species of animals that exhibit the transformation still in process. Such, for example, is the polar bear, which is about half aquatic. This animal really gave us the first hint that some mammals may revert to a water stage of existence.⁴ His body, much longer and more flexible than that of common bears, enables him to adapt himself to water locomotion. His feet have become decidedly broad, his head pointed, and his ears small, thus enabling him to propel himself through his aqueous habitat with ease. Other bears hug their prey, while this one uses teeth and claws entirely. The soles of his feet have become provided with long hair, which provide against slipping on the ice. They have largely lost their hibernating habits, and fish and hunt throughout the winter.⁵ The seals show by the shape of their skull, dentition, and mode of life that they are carnivorous animals that have adapted themselves to a life in water. Their limbs are metamorphosed into fin-like rudders.

Instead of a perfect fish-like tail he has two legs flattened together, with nails on the toes. These are obvious superfluities, but remain as an inheritance from ancestors to which they were of use, but they have now become modified by the present fish-like habits of the animal. Sea otters, the nearest relatives of the seal, have also become pure fish-eating animals. The

¹The Mammalia, p. 248; see, also, J. G. Romanes, Darwin and after Darwin, I, 50.

²Romanes, Darwin and after Darwin, II, 51.

³The Mammalian, p. 250.

⁴Arabella Buckley: Winners in Life's Race, p. 295.

⁵*Op. cit.*, pp. 295-8.

Sirenia,¹ which comprise the dugongs and manatees resemble the true *Cetacea* (whales, dolphins and porpoises) in their adaptation to an aquatic mode of life and the absence of pelvic limbs, but are probably more nearly allied to the *Ungulates*. These now aquatic animals are plainly retrogressions from the regular land type. They are somewhat fish-like in form, the posterior portion of the body being developed into a caudal fin. Hind limbs are lacking, and the forelimbs have been modified into swimming-paddles or flippers. The ear has lost the external concha. A few bristles still cover the thick skin and tell of former life. They are vegetable feeders (called herbivorous Cetaceans by Cuvier). There are two mammary glands, pectoral in position. The pelvis is rudimentary, some teeth are rudimentary, and some species possessed a rudimentary femur. They date back to the Eocene Tertiary period, while the cetacea probably extend to the secondary period.

Among reptiles which represent these atavistic traits there are the oceanic turtles, and the sea snakes; among the birds, the penguin, whose wings are scarcely different from the true fins of fishes. Then, again, from the mammals might be named the web-footed, duck-billed platypus, the web-footed opossum of South America, the beaver, and the walruses and sea lions.²

In all these classes of animals that have returned to aquatic life, we notice that in the process of evolution the most marked changes have taken place in the least typical structures,—those which are least strongly inherited, such as skin, claws and teeth. The aqueous medium necessitates a change of covering. Instead of fur, which we know (from the few straggling bristles) they once possessed, a smooth surface, offering little resistance is advantageous. To still maintain adequate bodily heat a covering of fat under the skin is acquired. The whale has evolved a layer of blubber in some cases one and one-half feet thick. The changed medium modifies the locomotor organs—does away with the necessity of legs and necessitates, instead, swimming apparatus. The anterior end becomes more pointed to reduce resistance to the minimum. It should be noted, however, that the head retains essentially all the functions it possessed, being modified only in form. In all cases the eyes become much reduced in size. In whales they suffer so much reduction that they can scarcely be found. The same change is taking place in the eyes of seals, polar bears, walruses, and other animals of this type. Dentition has suffered so much change that whales possess only rudimentary teeth that never cut the gum. In the living species of sirenians the jaws carry

¹ Nicholson: Manual of Zoölogy, Chap LXVI.

² Arabella Buckley: Winners in Life's Race, p. 299.

more or fewer molar teeth, which have flattened crowns, while the front of the upper and lower jaws is furnished with rough horny pads or plates. In the genus *Rhytina*, now extinct, there were no true teeth, but the places of these were taken by plates of horn. Incisors are also present, but they do not cut the gum, except in the case of male dugongs. Nostrils become situated on the upper surface. The anterior organs of locomotion suffer much less change in form than the posterior, though they assume entirely new functions. In general the bones of the shoulder, forearm, wrist and fingers, are retained, although they become encased in a fin-shaped sac, so as to become better fitted for swimming.

The entire posterior end, as well as the hind legs, undergo a most radical metamorphosis. The hind legs are no longer needed for walking, and soon atrophy entirely or become merely rudimentary. In the whales, porpoises, and other animals, which have completely forsaken the land, the hind legs have completely disappeared externally, and only the rudimentary bones give evidence of the species ever having possessed legs. Synchronously with the atrophy of the hind legs there occurs a loss of the sacrum and pelvis. In the sirenians there is no true sacrum, and the pelvis is only rudimentary. The lungs instead of degenerating become enormously enlarged, and enable their possessors to remain under water great lengths of time. The whalebone whale can remain under water for an hour at a time without reinflating its lungs.

The reversion to an aquatic medium seems to be promotive of great increase in size. This is probably due to several causes. First, the expenditure of energy in locomotion is greatly reduced; second, the ease of securing food is greatly increased, the whale having only to open his mouth as he swims to entrap myriads of minute marine animals; third, it is probable that the loss of a pelvis is advantageous, as much larger young may be born without injury than when the pelvis is present. Among land vertebrates we know that many of the largest and most promising of the various species succumb to the dangers, attending birth, arising from a narrow pelvis.

Psychic Reverberations. We cannot hope to unravel all of man's mental history with any such demonstrable certainty as we can reconstruct his past physical history. Mental states are the most fleeting and least preservable entities, and although we must logically conclude that the record of no psychosis is ever effaced, yet the majority become so intricately blended and interwoven and overgrown with other more recent acquisitions that no psychology will ever be able to reconstruct the entire race history. Only the most oft-repeated and most far-reaching psychic acts leave traceable evidences. But patient and careful

work will enable us to understand much of man's psychic past through survivals and rudimentary organs, just as we have been aided in tracing psychical development. But just as all psychic organs are less demonstrable than physical, so rudimentary psychic phenomena are less capable of proof than vestigial physical structures. There is, however, unquestioned evidence of numerous rudimentary psychic traits and many others which, though not capable of rigorous demonstration, give strong evidence of their origin. Traces of peculiar manifestations of the souls of our remote ancestors are to be met with in "the present reactions of childish and adolescent souls, or of specially sensitized geniuses or neurotics." There are also times in the life of the normal individual when the control maintained by the higher and more recently acquired centers is apparently suspended, and the lower and older centers then given full sway seem to step in, and the resulting psychical phenomena present traces of long past activities. Such conditions are evidenced in sleep and dreams. Idiots present childish and even animal mentality, showing that the higher centers have failed to function. Instead of evincing rudimentary psychic phenomena in the true sense, they are cases of arrested development. Their lives are made up of those activities that are common to animals and to humanity in its infancy. Again, there are certain modes of thought that crop out in the form of omens, superstitions, sayings, proverbs and signs, to which we ordinarily attach no importance, but often hear and repeat. All these have a meaning to the psychologist. They are to him vestigial or rudimentary organs, and suggest use in a remote past. "Few things," says Black,¹ "are more suggestive of the strange halts and pauses which mentally a people makes than to note how superstition springs up in the very midst of modern education." They are to the psychologist what gill-slits are in pathological cases of arrested development. Children are very prone to be superstitious, which is also true of savages.

The range of atavistic psychoses is practically unlimited. Admitting memory to be a biological fact we assume that every impression leaves an ineffaceable trace, by which we mean that vestiges or predispositions or habit-worn paths of association are formed which will function again when properly stimulated. Conservation of impressions is a state of the cerebral organism. The effect once produced by an impression upon the brain, whether in perception or in a higher intellectual act, is fixed and there retained. The retention of any act in memory, according to James,² is an unconscious state, purely physical, a

¹ Folk Lore in Medicine, p. 218.

² Prin. of Psych., I, 655.

morphological feature. According to Ribot we may assume that persistence of memories, "if not absolute, is the general rule, and that it includes an immense majority of cases."¹ This, of course, applies only to the persistence of memories during the individual's life, but, as Dr. Hall has pointed out,² "we may fancy, if we like, that on some such theory as, *e. g.*, Mach's of hereditary, or a form of memory by a direct continuity of molecular vibration in cells or their elements (Weissmann's biophors, Wisner's plasomes, de Vrie's pangens, Nägeli's micellæ, etc.), or in any less material way," that these traces or vestiges are continued, and may, even though apparently forever effaced, reappear in future generations in children or pathological cases. Multitudes of impressions, even in the individual's existence, may never be recalled, but they might be if the proper stimulus occurred, or if more recent memory modifications were removed, and the older memories, as it were, set free. Evidence in support of such a theory is furnished by pathological cases. Events long since apparently forgotten often reappear in disease. This is accounted for by the destruction of the more recent and higher centers. According to Ribot the law of regression is that a progressive dissolution of the memory proceeds from the least organized to the best organized, from the new to the old. In physiological terms "degeneration first affects what has been most recently formed." In psychological terms "the complex disappears before the simple, because it has not been repeated as often in experience." Hence, may not such cases give us glimpses of the remote psychic past, even of the paleo-psychic age?

In sleep we have similar conditions. The higher centers having relaxed their control, there flash into consciousness great accumulations of old experiences that we did not know we possessed. Those which are the most retrospective and atavistic take us back through the remote periods of the development of the race consciousness. In the psychic life of sleep our consciousness may extend backward to embrace all that our ancestors have lived and felt and bequeathed to us as an indestructible organic patrimony." Some of the somnolent phenomena certainly point to aquatic existence. Consider the sensations of flying, hovering, swimming, floating, and jumping indefinitely, as with seven-leagued boots. Nearly everybody can bear testimony to these sensations. Sometimes it is a sort of skating or gliding across countless miles of country or of ocean, sometimes it is a giant-like striding from mountain-top to mountain-top, sometimes the perfect eagle-swoop through the blue of

¹ Diseases of Memory, p. 185.

² Amer. Jour. of Psych., Vol. VIII, 173.

space, effortless and superb. Many testify to taking hundred-mile steps, for jumping contests imaginarily performed in sleep are of such a character as would excite the admiration of the fabled gods. These states undoubtedly arise from disturbed circulation and respiration, for both of these acts are much deranged in an actual fall through space. And, as Dr. Hall suggests,¹ "as lungs have taken the place of swim-bladders, the unique respiratory action of hovering, as in nightmare, with all the anakataesthetic phenomena, and perhaps the eluæsthetic sensations of a falling, which are quite distinct from the former, although not without common elements, suggest the possibility that here traces of function have survived structure. . . . Our ancestors . . . floated and swam far longer than they have had legs . . . and why may there not be vestigial traces of this, as there are of gill-slits under our necks? . . . Although it cannot be demonstrated like rudimentary organs, I feel strongly that we have before us here some of the oldest elements of psychic life, some faint reminiscent atavistic echo from the primeval sea."

The study of methods of suicide offers some very interesting data to the psychologist. The characteristic mode of procedure adopted by different nations throws light upon racial psychology, while the differences in the methods employed by men and women in accomplishing this terrible deed throw considerable light upon sexual psychology. All statistics show very strikingly that many more women than men commit suicide by drowning. And women choose this method more often than any other. This represents a fundamental psychic difference between men and women. The woman represents the oldest and most primitive features of the race ; the man that which is more recent and artificial. This is also true from a biological standpoint. Woman's body seems to be somewhat more primitive and conservative than man's. This is witnessed in her greater nearness to the quadrupedal position, in the length of body, smaller size, etc. Woman represents that which is more conservative in the race. In woman there are seldom abnormalities of bodily structure, and variations are much less pronounced than in man. "From an organic standpoint, therefore, men represent the more variable and the more progressive element, women the more stable and conservative element in evolution. . . . In various parts of the world anthropologists have found reason to suppose that the primitive racial elements in a population are more distinctly preserved by the women than the men."² Of their mental characteristics the

¹ *Am. Jour. Psych.*, VIII, Jan., 1897, p. 158.

² Havelock Ellis: *Man and Woman*, p. 367.

same authority writes that "on the psychic side women are more inclined than men to preserve ancient customs and ancient methods of thought."¹

If it be true that women are phylogenetically nearer primitive human beings than man, it is not strange that in methods of suicide they should choose the primitive and more natural means oftener than man. It would be strange were the statistics otherwise. The theory has often been advanced that the methods of suicide selected have a close connection with the occupation of the persons during life. To illustrate, a soldier would choose firearms, a druggist poison, etc. The theory is probably in a large measure true, but it in no way vitiates the theory that the most primitive and most conservative choose the most primitive methods. Statistics show that men prefer active methods, while women prefer passive methods. Women give themselves to the power of natural forces or elements, as, for example, to gravity when they throw themselves from heights or into the water and then wait for the end, while men make themselves the active agent in manipulating some artificial contrivance, a pistol, a rope, a bomb-shell, or the like. Many more women than men suicide by taking poison, which Dr. Chamberlain has pointed out to be an atavistic tendency. Women were the earliest agriculturists, and earliest learned the use of vegetables as articles of diet, as curatives, and as agents of destruction. From these early employments of women she learned to be a vegetarian, a trait she still possesses, and she earliest learned the use of poisonous herbs. The result of this last still reverberates through her organism, and to-day when woman determines to exterminate a fellow-being or an animal, poison is about the only means sought, while a man would employ a gun, a knife, or an explosive. In attempting her own life, though poison is often resorted to, a more primitive method is more often chosen. "Throughout Europe the law roughly stated is that men hang themselves; . . . with modifications this rule probably holds good all over the world."² In India, where the people represent a more primitive stage, according to Cheevers,³ six out of every seven women who commit suicide seek drowning as a means. The proportion of men who drown themselves is also greater there than in other countries. In the Celto-Latin nations, France, Italy, Belgium, Sweden, Switzerland, drowning among women shows the highest percentages of any countries. For some reason or other among the Slavic nations

¹ Havelock Ellis: *Man and Woman*, p. 368.

² Havelock Ellis: *Man and Woman*, pp. 334-5.

³ Quoted by Ellis: *Man and Woman*, p. 335.

drowning is at a minimum.¹ Strange to say, the atavistic tendencies are becoming stronger, according to Havelock Ellis, who says that "hanging has become much rarer in both men and women, while drowning and poisoning have become commoner in both. That is to say, that women have become more womanly than ever in their preference for the passive methods of suicide."²

May not many cases of suicide by drowning and the otherwise unexplainable "drawing power" of water so frequently experienced, be explained by supposing a temporary or permanent suspension of control by the higher psychic centers allowing a recrudescence of the old love for aquatic conditions. The fear which has been later formed, and which normally is in equilibrium with the love of water becomes overbalanced, and hence the desire to jump in. The philosopher, August Comte, during a fit of temporary insanity insisted on plunging into the lake with neither thought nor intention of drowning. The returns to my syllabus furnish many cases which attest to the feeling that water exerts a peculiar attraction for many individuals.

The sight of waves, billows, or in fact any water, makes some desire to ride upon it; many want to plunge in, and others are tempted to follow the streams. Some cannot go bathing without feeling an imperative impulse to go down forever; to leave care and pain; to end life; so they won't know any more, etc. One says she always thinks like Longfellow: "Oh that the river might bear me away on its bosom to the ocean wild and wide." During trouble many long to escape from it all by plunging in and being engulfed by the rushing waters.

WATER IN PRIMITIVE CONCEPTIONS OF LIFE.

We shall see that in all early Greek philosophy water was an integral part in all conceptions of life. Some assumed it to be the origin of all things; others said that water was *one* of the primitive elements, and that all plants and animals either came from or were made of water. The same ideas were current in mythology, and are prevalent among some people to this day. Peoples like the Egyptians, and those in southern and western Asia, who lived in countries subject to periodic drouths, were not long in concluding that water was necessary to the germination and growth of plants. During dry weather vegetation withered; during periods of abundant rain it waxed vigorously. They very naturally ascribed to water the powers of a supernatural being. It became to them not a condition of life, but the origin of life itself.

¹ Havelock Ellis: *Man and Woman*, p. 336.

² *Ibid.*

The potency and life-giving properties ascribed to water are shown in Egyptian writings where "it appears in such phrases as 'spirit of water,' the source. It is a conspicuous hieroglyphic in the verb 'to live;' also in 'living' and light."¹

Among the Ojibwas it is supposed to have magic power over life and death. It is not strange that among the Egyptians, where the annual overflow of the Nile meant life itself, that water deities should assume so important a place. The river was presided over by the god Nilus. The most important Egyptian festival was the one held at the annual summer solstice in honor of the Nile.² At this time an invocation was made to the river deity for the inundation. An image of the god Nilus was encircled by a serpent, and from beneath the rocks of a cataract a hydra poured forth sacred water.

The idea of resurrection undoubtedly grew, in part, out of the common observation of plant life. Vegetation flourishes during a season, appears to lose all vitality during a succeeding season, but when spring returns it becomes once more rejuvenated. Again, plants flourish, produce seed, and wither away. The seed in turn, under proper influences, germinates and produces new plants. It was but a step to arrive at the belief that man also, after death, must live again. We have seen that the primitive mind regarded water as the rejuvenating principles of all plant life, and hence it will not appear strange that the notion should be extended to include the resurrection of man.³ Among the ancient Egyptians the ceremonials of the dead all indicated an expected resuscitation of life, and water was always made the emblem of rejuvenescence, whether in connection with human dead or with plants. In the Book of the Dead, water was the symbol of revivification. They "believed in the resurrection of the dead through the same fertilizing power as that which regenerates the plant world."⁴ Primitive peoples generally, we may say, have taken cognizance of water in the ceremonials over the dead. And the return of life is always spoken of in connection with it. In Egypt funeral processions always had to pass by the sacred lake, which was near every city, and consecrated to the dead. In their funeral rituals the departed soul is represented as a ship with four rudders pointing to the four cardinal points. The ancient Hindoos buried the dead beneath the bed of a stream whose current was temporarily turned aside. The Greenlanders say that when one sleeps by the river he can hear the singing of the dead. Some Australians say that the soul, which they call the "little body," goes into the sea at death.

¹ Ellen Emerson: Rain Ceremonials, American Anth., Jul., 1894.

² Frazer: The Golden Bough, I, pp. 15-17.

³ *Op. cit.*, I, p. 93.

⁴ Ellen Emerson: Rain Ceremonials, Am. Anth., Jul., 1894.

Various symbolisms were early adopted to signify water. In Egypt it was Ptah, the frog, the "Father of Fathers," who was a symbol of the vital principle in water, its principle of reorganization. The hieroglyphic representing Ptah was regularly placed in the tombs of the dead. Its office was at some future time, to reunite the scattered parts of the body. Among some Indian and various other tribes the serpent symbolizes the watery element, air or breath, which are necessary to life.¹ We have also noted in various rain ceremonials the position of frogs, toads and serpents. In Babylonia, Thammuz was supposed to be resurrected by the water of life which the goddess Aphrodite brought up from Hades. That water was regarded by the Indic Aryans as the source of all things is shown in the Rig Vedas which tell us that "waters contained a germ from which everything sprang forth." The Peruvians worshipped Mama-cocha, the mother sea, from which had come everything, even giants, and the Indians themselves. In Peru water was everywhere worshipped, and it was believed that the Incas originated in lake Titicaca, while other fabled tribes came from fountains and streams.²

The rain ceremonials performed by various peoples for the purpose of securing rain are of exceeding interest. Although the details vary considerably the ceremonials may all be classed under a few heads. Sometimes rain is sought to be produced by *sympathetic magic*,³ that is, it is believed that by imitating some of the attendant phenomena they can influence the course of nature. For example, by beating on a kettle to imitate thunder, knocking two fire-brands together and causing sparks to fly to imitate lightning, and sprinkling water from a vessel by a bunch of twigs, as is done in some parts of Russia, the people believe that rain will be produced.⁴ Many tribes take a mouthful of water, spirt a part of it into the air, thus making a fine mist, to simulate rain. This is common among the Omaha Indians and certain other tribes.⁵ In Germany and France it is said to be customary to throw water upon the last sheaf cut at harvest. The same custom prevailed in England and Scotland until recently. In Transylvania among the Roumanians a girl wears a crown made of the last cut grain. When she comes home all hasten out to meet her, and throw water upon her until

¹ See Ellen Emerson : Rain Ceremonials, Am. Anth., July, 1894, for account of Egyptian and N. Am. Indian rain ceremonials; also Weather-making, Ancient and Mod., Mark W. Harrington, Smithsonian Rep., 1894.

² Dr. Chamberlain : The Child and Childhood in Folk Lore, pp. 38-9.

³ Ellen Emerson, *op. cit.*

⁴ Frazer : Golden Bough, I, p. 13.

⁵ *Op. cit.*, p. 15.

she is completely drenched. This is done to insure rain for next year's crop.¹ Sympathetic magic among the savages, Mr. Frazer regards as exactly analogous to the modern conception of physical causation. A man-god in this view, is only an individual who is believed to possess the power of influencing nature to a high degree.²

Another way of trying to secure rain is by *coercion* of the *rain-god*. In some parts of China a huge wooden or paper dragon, representing the rain-god is carried about in a procession. If no rain follows they curse it and demolish it. The Senegambians throw down their fetishes, drag them about the fields and curse till rain falls.³ Still another way is to *disturb the gods* in some way. Troubling the sacred springs by throwing impurities into them is believed by the Dards to bring rain. Other springs need only to be looked at and the whole province secures rain.⁴ Sometimes an appeal is made to the *pity of the gods*. The Zulus kill a "heaven bird," throw it into a pool, "then the heavens melt with tenderness for the death of the bird; it wails for it by raining, wailing a funeral wail."⁵

Various other methods are resorted to in different parts of the world. The Samoan rainmakers wet some sacred stones when they wish rain, and put them into the fire when they desire dry weather.⁶ In China Ke-mung, who is man-shaped and dragon-headed, haunts the Chang River and causes rainstorms.⁷ In the same country water-spouts are said to be caused by dragons fighting in the air.⁸ The *Dodola* or girl dressed in clothes made of grass, herbs and flowers, who goes about from house to house and sings while the housewife pours water over her, is a common rain-charm in southeastern Europe. It is found among the Servians, Greeks, Bulgarians and Roumanians.¹ Beating, pinching, and beheading frogs is quite a common rain-charm among the Orinoco Indians, and killing the frog is an old German rain-charm.²

WATER IN PHILOSOPHICAL SPECULATION.

Not only among savage tribes has water played an important rôle in their mythological explanation of the world, but even in philosophic thought water has been the subject of much speculation. It assumed an important place in early Greek *cosmo-*

¹ *Op. cit.*, I, p. 286.

² *Op. cit.*, I, p. 12.

³ *Op. cit.*, I, p. 18.

⁴ *Op. cit.*, I, p. 19.

⁵ *Loc. cit.*

⁶ Tylor: *Early History of Mankind*, p. 133.

⁷ Denny's *Folk Lore of China*, p. 98.

⁸ Conway: *Demonology and Devil-lore*, II, 107.

logical theories. The Greek philosophers were not the first to form theories of the origin of the universe ; such theories, more or less mythological of course, were extant among all tribes. But the Greeks were the first to seriously attempt to understand nature. Burnet says " the real advance made by the scientific men of Miletos was that they left off telling tales."¹ They had noticed the constantly changing aspects of nature, the eternal flux as Heracleitus later puts it, and their minds began to grope and yearn for some unitary principle to which the eternal succession of changing objects could be reduced. They did not, it is true, abandon the speculation concerning origins, but their scientific contribution was the search for a unitary principle in what was present. " They gave up the hopeless task of describing what was when as yet there was nothing, and asked instead what all things really are now?"² Parmenides asserts that " nothing comes into being out of nothing, and nothing passes away into nothing." But they observed the continual coming into being and corresponding passing away of particular things. From this it was natural to pass to the assumption of a substratum which was the ultimate and only reality. As " nothing comes from nothing, nothing can pass away into nothing, there must then be something which always is, something fundamental, which persists throughout all change, and ceases to exist in one form only that it may reappear in another."³

It is interesting to note the cause of the change in cosmological doctrine among the early Greeks. Much of the change was undoubtedly due to the increased knowledge of the sea, which had hitherto represented to them the boundless, at least so far as mortal knowledge was concerned. What was unattainable, beyond reach, unexplainable by natural means, was placed beyond the sea. Their world was bounded by the sea, it rested upon the sea, the mythical heroes dwelt in or beyond the sea. But with the increase of maritime knowledge in the 5th and 6th centuries B. C., old conceptions had to be abandoned for something new. At the time the *Odyssey* was composed, Odysseus met with Circe, the Cyclops, and the Sirens, not in the near and familiar *Ægean*, but in the " West," which meant to them beyond the known sea.⁴ But with the increase of geographical knowledge it was discovered that the monsters and beings purported to be the inhabitants of countries beyond the sea, were no longer

¹ J. Burnet: *Early Greek Philosophy*, p. 8.

² Burnet: *op. cit.*, p. 8.

³ Burnet: *op. cit.*, p. 10.

⁴ Geo. Grote: *Hist. of Greece*, I, 342-3.

there, and a doubt of their ever having been there arose.¹ About this time they changed the name of the "Inhospitable Sea" to the "Hospitable Sea."² They had determined the location of the "far country," and Jason was made to bring the Golden Fleece from a definite place Kolchis.³ Burnet says, "above all, the Phokaians had explored the Mediterranean as far as the Pillars of Herakles, and the discovery that the 'endless paths' of the sea they knew had definite boundaries must, as Grote has said, have moved men's minds in much the same way as did the discovery of America in later days."⁴

To return to their cosmological theories, we can readily understand how in their search for the eternal, original, unitary substance through whose changes and motions all else arose, that they should turn to those things which were either ever present, most abundant, or presented the greatest possibility of change, but which at the same time appeared to possess some simple form beyond which further change was impossible. This the various philosophers thought they discovered in the elements,—earth, air, fire and water. Some chose one, some another, and still others believed that all were necessary for a satisfactory explanation.

Thales, the founder of the Milesian school, and probably the first of the cosmologists in seeking a primary, fundamental matter, something which would answer the question: Of what is the world made? proposed the answer: *water*. All special existences were but modes of this primary substance. He saw about him "constant transformations—birth and death, change of shape, of size, and of mode of existence—he could not regard any one of these variable states as Existence itself. . . . He looked around him, and the result of his meditation was the conviction that Moisture was the Beginning. He was impressed with this idea by examining the constitution of the earth. There, also, he found moisture everywhere. All things he found nourished by moisture; warmth itself he declared to proceed from moisture; the seeds of all things are moist. Water when condensed becomes earth."⁵ Further, as Burnet points out the process that evaporation was continually going on around them, the phenomenon which rural people call the "sun drawing water" was then as observable as at the present day, and the conclusion was probably similar. The Greeks went a little further than the rustic of to-day, and asserted that this water passing into the sky by evaporation went to feed the heavenly

¹ *Op. cit.*, p. 334.

² J. Burnet: *Early Greek Philosophy*, p. 14.

³ *Ibid.*

⁴ *Ibid.*

⁵ Geo. H. Lewes: *Hist. of Phil. from Thales to Comte*, Vol. I, p. 7.

fires. After coming down in rain they thought it changed into earth. Then from the phenomena of mists and subterranean springs they believed that earth once more was converted into water. They did not connect springs with rain, and the waters underneath the earth were regarded as an independent source of moisture.¹

Anaximander (610 B. C.) did not agree, saying that the elements "are in opposition to one another,—air is cold, water moist, and fire hot,—and therefore if any one of them were infinite, the rest would cease to be by this time."² He regarded the world, according to Burnet, as a boundless mass or body out of which "our world once emerged by the 'separating out' of the opposites, moist and dry, warm and cold."³ But, although *Anaximander* made a great advance over the ideas of *Thales*, no longer considering the earth as a disc resting upon the waters, the potency of moisture or of water was still clearly visible in his system. His ideas of the origin of living creatures, as chronicled by *Theophrastus*,⁴ are as follows: "Living creatures arose from the moist element as it was evaporated by the sun. Man was like another animal, namely, a fish, in the beginning." *Hipp. Ref.*, i, 6 (R. P., 16 a).

"The first living creatures were produced in the moist element, and were covered with prickly integuments. As time went on they came out upon the drier part, and, the integument soon breaking off, they changed their manner of life." *Aet.=Plac.*, v, 19. 1 (R. P., ib.).

"The sea is what is left of the original moisture. The fire has dried up most of it and turned the rest salt by scorching it." *Aet.=Plac.*, iii, 16. 1 (R. P., 14 c).

Anaximenes (588 B. C.) appears at first sight to have taken a different element from any of his predecessors as the one underlying substances from which all things come. According to the account given by *Theophrastus* "from it . . . (air) . . . the things that are, and have been, and shall be, the gods and things divine, took their rise, while other things came from its offspring." *Hipp. Ref.*, i, 7 (R. P., 21).⁵ Burnet explains, however, that "the 'air' of which *Anaximenes* spoke was not at all what we call by that name. The word *ἀήρ* is still used in its old Homeric sense of vapor or mist. The discovery that what we call air was corporeal, and not identical with empty space, was first made by *Empedokles*. In all the earlier

¹ J. Burnet: *Early Greek Philosophy*, p. 45.

² Quoted by J. Burnet from *Aristotle's Phys.*, *Early Greek Philosophy*, p. 51.

³ J. Burnet: *Early Greek Philosophy*, p. 61.

⁴ These references quoted by J. Burnet, *Early Greek Phil.*, pp. 73-94.

⁵ *Loc. cit.*, p. 77.

cosmologists *ἀήρ* means water in a vaporous state more or less condensed."¹

Below are quoted several passages of the *opinions* of Theophrastus which give the key to the cosmology of Anaximenes.

"When it is dilated so as to become rarer, it becomes fire; while winds on the other hand are condensed air. Cloud is formed from Air by 'felting,' and this, still further condensed, becomes water. Water, condensed still more, turns to earth; and when condensed as much as it can be, to stones." Hipp. *Ref.*, Aet. (R. P., 21).²

Thus we see Anaximenes practically returning the view of Thales, making everything come from the *ἀήρ* or moisture, and even holding that the disc-shaped earth floated upon it.

Xenophanes, though not making himself clear concerning his cosmological theories, seems to incline largely to the Anaximandrian view. Though he denied the conception of a primary substance³ he says:

"All things are earth and water that come into being and grow."⁴ R. P., 86.

"For we all arise from earth and water." R. P., 86.⁵

Heracleitus (504 B. C.), not satisfied with former cosmology sought a new principle, out of which the diversified world might be made, which would change into everything else, and which would be produced by everything changing back into it. This he thought he found in "fire—real fire, of course, 'that burns and crackles,' as Teichmüller put it."⁶ Many interpreters, however, regard this fire as only symbolic, and claim that the word was used with the same significance as Anaximenes had used air, that is meaning mist or moisture.⁷ Be this as it may, Heracleitus regarded fire, water and earth, as the fundamental forms which water assumed in its transformation⁸ in his celebrated "flux" theory gives to water great prominence.

Theophrastus records that "he called change the upward and the downward path, and held that the world goes on according to this. When fire is condensed it becomes moist, and when collected together it turns to water; water being congealed turns to earth (the conjecture of Theophrastus); and this he calls the downward path. And, again, the earth is in turn

¹ *Loc. cit.*, p. 78.

² *Loc. cit.*, p. 81.

³ *Loc. cit.*, p. 124.

⁴ *Loc. cit.*, p. 115.

⁵ *Ibid.*

⁶ *Op. cit.*, p. 148.

⁷ *Op. cit.*, p. 148 for discussion of interpretation; also Zeller, *Pre-Socratic Philosophy*, II, 51 ff.

⁸ Zeller: *Pre-Socratic Philosophy*, II, 51.

liquified, and from it water arises, and from that everything else; for he refers almost everything to the evaporation from the sea. This is the path upwards."¹ R. P., 29.

From Hippolytas, who probably represents Heraclitus accurately, in Mr. Bywater's edition we learn that Heraclitus believed that "the transformations of Fire are, first of all sea (and half of the sea is earth, half fiery storm-cloud)". R. P., 28 b.²

"The earth is liquified, and the sea is measured by the same tale as before it became earth."³ R. P., 31.

Heraclitus believed that there was a constant flux between fire and water. One prevailed for a time, then the other, but that neither gained the permanent ascendancy. The balance was maintained by the "measures," as he called them. Measures of "ever-living fire" were ever going out, while compensatory "measures" were being kindled.⁴ He writes, "so long as things as they are, fire and water will always be too, and neither will ever fail." Ps. Hipp., *De Diaeta*, i, 3.⁴

By the oscillation between fire and water Heraclitus explained the change of seasons, and day and night. Like the heavenly bodies man, also, oscillates between fire and water.⁵

Hippolytas interprets Heraclitus as saying :

"The dry soul is the wisest and best."⁶ R. P., 34.

"For it is death to souls to become water, and death to water to become earth. But water comes from earth; and from water soul."⁴ R. P., 30 B.

"It is pleasure to souls to become moist."⁴ R. P., 38 b.

"A man, when he gets drunk, is led by a beardless lad, knowing not where he steps, having his soul moist."⁴ R. P., 34.

Empedocles held that there were four fundamental and primary elements, fire, earth, air and water.⁷ According to him plants and animals are composed of fire and water in definite proportions. Likewise man sprang from the earth, at first composed of shapeless lumps of earth and water, thrown up by subterranean fire, which gradually shaped themselves into human members under the influence of Love.⁸

Anaxagoras followed in a large measure the cosmological doctrines of *Anaximenes*. He taught that plants and animals all originated in germs which came down in rain-water.⁹

¹ Burnet: *op. cit.*, p. 151.

² Burnet: *op. cit.*, p. 135.

³ Fragment 20. Quoted by Burnet, *op. cit.*, p. 135.

⁴ Burnet: *op. cit.*, p. 135.

⁵ Burnet: *op. cit.*, p. 162.

⁶ Burnet: *op. cit.*, p. 138.

⁷ Zeller: *Pre-Socratic Philosophy*, II, p. 125, *et seq.*

⁸ Zeller: *op. cit.*, pp. 159-161.

⁹ Zeller: *op. cit.*, p. 365.

These cosmological theories, trivial as they may now appear, were of the utmost significance. Who would for a moment question the great importance of the atomic doctrine of elements? Probably no other hypothesis in ancient or modern times has been so potent in determining our knowledge of the physical universe. Now, in all these crude attempts to answer the question proposed by Thales, we can distinctly foresee the struggles toward, if indeed not the germs of, a future atomic theory. They were searching for the primitive, fundamental, unchangeable something from which all else was derived. "Greek philosophy began as it ended, for what was lasting and abiding in the flux of things."¹ Thales postulated water as this abiding something, Anaximenes *ἀήρ* or mist, Heraclitus fire, which, however, could not exist without water, Empedocles, earth, air, fire and water. Others asserted one or a combination, but in all these theories water played the chief, or at least not unimportant rôle in answering Thales' conundrum.

SACRED WATERS.

We have shown how water came to be regarded as possessed of life-giving powers through its connection with the growth of vegetation. Living or running water came to be regarded as of special sanctity. Early civilizations largely inhabited countries having periodic rainfalls, so that with the rainy season and overflowing streams, the apparent visitation of some supernatural powers were particularly noticeable. Gradually certain streams, lakes, pools, wells and fountains, became set apart as sacred. The sources of streams were held as particularly sacred. Temples and other sanctuaries were frequently erected on the banks of streams, and the stream formed an important part of the *sacra* of the place.

We have evidence of the sacredness of many rivers in the Orient. The Phœnecians and the Carthaginians held many rivers to be divine. Belus, Adonis, Æsclepius and the Kishon, were all held in veneration; also the pool of Aphaca, which was the most famous of all holy places. Several of these holy places were named from the ancestral gods. The river Tripolis is still called the Cadisha, or holy stream. The Jordan, in Biblical times, was the sacred stream of the Hebrews, as were the Abana and Pharpar of the Syrians. In Damascus the Barada was sacred, and figures of the river-gods Chrysorrhoa and Pegai often appear on Damascene coins. These gods were probably prominent in religious worship. The Euphrates was sacred to the Syrians, and bore an important part in the ritual of Hierapolis. From the river the goddess was thought to have

¹ Burnet: *Early Greek Phil.*, p. 13.

been born. The Aborrhās or Chaboras, the chief tributary of the Euphrates in Mesopotamia, was held sacred as the place where Hera (Atargatis) bathed after her marriage with Zeus (Bel). According to tradition the Orontes was carved out by a dragon which disappeared in the earth at its source. The river Cadas bears a name which implies its ancient sanctity.

Besides sacred streams, fountains, waterfalls, wells, pools, etc., were regarded sacred. Each village in Syria had its own well and its own high-place or little temple. In Canaan they were generally outside of the villages. Sacred springs were generally sought in places to which long pilgrimages had to be made. Such shrines were Mamre, Aphaca, Dan and Beersheba. Sometimes they were within the temples, and again, as at Antioch, the water and the groves surrounding formed public parks where pleasure and religious observances were combined.

Both legend and religious ritual give evidence that, at least in earliest times, the sacred waters themselves were deemed instinct with divine powers, and not that beings resided in them which possessed these magic gifts. The latter idea came in, but it is not the primitive one. Many of the legends attempt to explain how the waters became impregnated with supernatural powers. Many ancient accounts seem to indicate that the blood of the deity flows in the waters. In *Paradise Lost*, following Lucien in the Syrian account,

" Smooth Adonis from his native rock,
Ran purple to the sea, supposed with blood
Of Thammuz yearly wounded."¹

The red color of the river was supposed to come from the blood of the god killed. A fountain at Joppa was said to be colored from the blood of a sea-monster. In another class of legends the life of the water is derived from the blood of the gods who descend into them and die. This was said of the Euphrates, into which Hierapolis and Ascalon plunged and were changed into fishes. This, says Mr. Smith, is but another way of bringing the divine water or divine fish into harmony with anthropomorphic ideas. Aphrodite is said to have been born of the seafoam, which is but another way of saying that a deity had given its life to the water. Fish were taboo in Syria, and sacred fish were found in all sanctuaries. Sacred fish are still kept in pools at the mosques of Edema and Tripolis.

The early inhabitants of Switzerland probably worshipped the lakes. Ancient writers indicate that the Gauls, Germans and other nations, considered many lakes sacred. "According to Cicero, Justin and Strabo, there was a lake near Toulouse in which the neighboring tribes used to deposit offerings of gold

¹ *Paradise Lost*, I, 450, following Lucien in *Dea Syria*, viii.

and silver. Tacitus, Pliny and Virgil, also mention the existence of sacred lakes."¹ Gregory of Tours tells of a sacred lake on Mt. Helamus which was worshipped, and offerings of clothes, skins, etc., made to it.

Besides being sacred many of these waters were deemed to possess life-giving powers to all who drank of them or bathed in them. It was but an extension of the notion concerning the relation of rain and water in general upon vegetation to its effects upon man. Stories of fountains of youth abound in all lands, and the significance is great. It betokens the widespread faith that has been held concerning water as a life-giving agent, and the close identification of water with life. The magic draught of the fairy story, the Greek ambrosia, the Vedic Soma or amrita, which gave immortality, the Zend haoma, waters of strength and waters of weakness, rivers of life and fountains of youth, all seem intimately connected through the primitive notions from which they all arose. These draughts were the source of all strength and powers, panaceas for all ills. By imbibing magic waters, or bathing in them the old were made young, the infirm strong, and the blind to see.

In India there is a lake and river in which bathers could become as young or as old as they chose. Cambyes had heard of the long-lived Ethiopians, and despatched messengers to spy out their conditions of life. The Ethiopians were reported to live a hundred and twenty years, and the secret was that they bathed in a magic fountain. In the Hawaiian legend Tahita Kahiki, or the land *far away* may be found the *wai ora waiola*, or water of life, and the *wai ora roa*, or water of enduring life. These waters remove all sickness, deformity, or decrepitude from those who plunge beneath them.¹ The Sandwich Islanders have a tradition of a river in the spirit-world called Water of Life, which makes the aged young, and allows them to return to earth to live another life. Similar ideas have been found in the Malay Islands. Batara Gurr saves himself and the other gods from a poisonous drink by discovering a well of life. Nurtjaja compels the bandit Kabib to disclose to him the springs of immortality which flow beneath the caverns of the earth. Europe is not lacking in stories of miraculous fountains. "Ibu-el-Wardi places the Fountain of Life in the dark southwestern regions of the earth. El-Khidar drank of it, and will live till the day of judgment." Prester John wrote to Manuel of Constantinople in the 13th century that "at the foot of Mount Olympus bubbles up a spring which changes its flavor hourly day and night, and the spring is scarcely three days journey from Paradise, out of which Adam was driven. If any

¹ Sir John Lubbock : Pre-Historic Times, p. 222.

man drinks thrice from this spring he will from that day feel no infirmity, and he will as long as he lives appear the age of thirty.¹ Sir John Maundeville is said to have identified the mountain a century later as Polombo, near Ceylon. (Tylor gives it as Mt. Cytec.) He wrote that there "is a fayre Welle and a gret that hathe odour and savour of all Spices; and at every hour of the day he changethe his odour and his savour diversely. And whoso drynkethe 3 tymes fasting of the Waters of that Welle, he is hool of alle maner of sykénesse that he hathe. . . . And men seyn, that that Welle cometh out of Paradys; and therefore it is vertuous."²

During the Middle Ages the belief was current that one who bathed in the Euphrates in the springtime would be immune from disease the remainder of the year. This power also extended to the vegetation along its banks. Near the sacred Belus grew the colcasium plant which healed Heracles after his combat with the Hydra. Ezekiel speaks of the sacred waters that issue from the New Jerusalem, giving life wherever they went. The leaves of the trees along its banks were believed to have medicinal virtues. The fountain of youth was a much sought for object even in subsequent times. Ponce de Leon is said to have searched long and anxiously for it among the Bahamas, and the everglades of Florida, and even penetrated the New World as far as the Mississippi River in search of that which would rejuvenate his ebbing powers.

Healing Waters. Belief in the curative and even life-giving powers of certain water has persisted down to the present time. "The healing power of sacred water is closely connected with its purifying and consecrating power, for the primary conception of uncleanness is that of some dangerous infection; originally an infection of holiness, but later on of impurity."² (Studied more in detail later on.) There are numerous records of enchanted wells until recently, and possibly still regarded as possessing miraculous powers. Great Britain, Scotland and Ireland, furnish them in great numbers. Among the most noted was St. Winifred's in Flintshire, Wales. Its waters were deemed almost as potent as those of the pools of Bethesda. All human ills were supposed to be relieved by drinking from it or being bathed in it. The spot from whence the spring issues is the spot upon which St. Winifred's head fell when struck off by Prince Caradoc. It has many visitors to this day. In 1635 Sir George Peckham prolonged his devotions too far, "having continued so long mumbling his *paternosters* and *Sancta Wini-*

¹ W. Robertson Smith : Rel. of the Semites.

² W. Robertson Smith : Rel. of the Semites, p. 68.

freda ore pro me, the cold struck into his body, and after his coming forth from that well he never spoke more."¹

Hither came Wm. the Conqueror, his grandson, Henry II, and the first Edward; here, too, many of the Gunpowder Plot conspirators, and later James II. In 1876 the Duke of Westminster leased the well to the corporation of Holywell for a thousand years at a sovereign a year. At a recent date the following articles left by cured patients might have been seen by the curious visitor: 39 crutches, 6 canes, a hand-hearse, and a pair of boots. It is said of the two wells at Newton, near St. Neots, that "never went people so fast from church, either unto a fair or market, as they go to these wells."² In the parish of Wembdon, during the reign of Edward IV, immense concourses of people flocked to St. John's Well, and were said to be restored to health through its curative properties. With Chader Well, on the Island of St. Lewis, and also a well in Dumfriesshire it was either kill or cure: if convalescence did not immediately follow, death did.

Sacred wells were often the mediators in the transference of disease. At St. Elias's Well, Denbighshire, disease is transferred by casting into the well a pin, along with a pebble, marked with the intended victim's name. If the victim hears of it disease often occurs as a result of suggestion, but believed to have been transferred by magic. To remove the disease, the pebble is taken out and the victim's name erased from the magician's book.³ At the holy well, Tubber Quan, near Carrick on Suir, the faithful were, and probably are, wont to resort on the last Sunday in June to supplicate St. Quam and St. Brogaum. If cures are to be granted they appear as two wonderful trout. In Wales epileptic patients go to St. Telga's Well, half way between Wrexham and Ruthin. The patient goes to the well after sunset, washes in it, and makes an offering of four pence. With a fowl under his arm he walks around the well three times, reciting the Lord's Prayer. He then sleeps all night in the church with the Bible for his pillow. In the morning another six-penny offering is made to the well. If the fowl dies the disease is supposed to be transferred.⁴

A few years ago a lady was sketching on the banks of a river in Ireland when she "saw a young girl . . . leading a boy with a halter round his neck. When the pair reached the river the boy went down on his hands and knees, and so led by the girl crossed the river, bending his lips to drink. They then recrossed in the same fashion; he drank as before and she led. Then they went up the hill home. But presently

¹ W. G. Black: *Folk Medicine*, p. 103.

² W. G. Black: *Folk Medicine*, p. 39.

³ *Loc. cit.*, p. 46.

they again appeared coming down the hill. This time, however, the boy led the girl, otherwise the ceremony was the same. 'Me an' Tom's very bad with the mumps,' explained the little girl, raising her hands to her swollen neck and cheeks, 'so I put the branks on Tom an' took him to the water, an' then he put them on me. We be to do that three times an' its allowed to be a cure.' And a cure did result."¹ In the early part of the century sufferers from the whooping cough, Catholic and Protestant, drank holy-water from a silver chalice in the hope of a cure. Nurses in Gloucestershire used invariably after public baptism to wash the infant's mouth with the holy water. It was said to be a safeguard against toothache. Such a value was placed upon this water that to prevent the people stealing it, the fonts had to be kept locked. In the Puritan portion of western Scotland it was looked upon as having power to cure many disorders. Further, it was a preventive against witchcraft, and eyes bathed in it would never behold ghosts.² It is said of the Borgia Well, at Cambuslang, near Glasgow :

"A drink of the Borgia, a bite of the weed,
Sets a' the Cam'slang folk wrang in the head."

On the 26th of June, every year, people flock to Saw Beach, Maine, for a healing dip which the waters are thought to provide on that day.

The Chinese do not like to have running water near their dwellings because it runs away with their luck. Scotch and English peasants believe it will bear away evil, and thus attach great value to it. Some think that to possess desirable qualities the stream must run east, others think south. The latter is usually regarded the more auspicious, being particularly efficacious in cure of witchcraft, a series of three mighty plunges being required for a cure. In Northumberland whooping-cough was cured by porridge cooked on a griddle held over a south-running stream. At one time the number of patients was so large that they could get but a spoonful at a dose.

Offerings. A further proof that the divine potency was supposed to reside in the water is shown by the form of religious ceremonies observed when offerings were made to the water. At Mecca and at the Stygian waters in the Syrian desert gifts were cast into the holy sources. Even at Aphacus, where the goddess Astarte was believed to descend into the waters, the pilgrims cast into the pool webs of linen and byssus, gold and

¹ J. G. Black: *Folk Medicine*, pp. 105-6, from *Univ. Mag.*, Aug. 1879, p. 219.

² J. G. Black: *op. cit.*

silver jewels and other valuable materials. At Abraham's Well, Mamre, the heathen visitors cast into it libations of wine, cakes, coins, myrrh and incense, and illuminated the well at night with lamps.¹

The custom of leaving rags and other worthless things at holy wells still exists in Ireland and Scotland as well as in remote parts of the world. A traveller in Persia found a tree near one of these wells hung with rags, which had been left there by people afflicted with ague. An African explorer found a tree hung full of rags. Old clothes, crooked pins, pebbles, shells, rusty nails, coins and other useless objects, all form appropriate offerings. The superstitious adoration was so great in the reign of King Edgar that it was forbidden by the 16th canon issued in 960, and it was condemned by the canons of St. Anslemus in the next century. In the reign of King Canute it was also interdicted by law. The practice has been limited since the Reformation. But there is still scarcely a parish in Ireland but has its own holy well.²

Oracular Powers. Holy waters have often been places of oracle and divination. They were supposed to indicate by some sign the favorable or unfavorable disposition of the divine power, and also to show whether certain gifts were acceptable or not. At Aphaca acceptable offerings sank, and unacceptable ones were thrown back by the eddies. The gifts deposited one year were thrown back the next, which was regarded as an ill omen, betokening the fall of Palmyra. In Greece holy wells gave prophetic inspiration to those who imbibed their waters. The oracle at Antioch was obtained by dipping a laurel leaf into the water. The oracular power of water has often been used to determine the curability or incurability of disease. In recent times it was customary at St. Orwald's Well, Holywell Dale in North Lincolnshire, Great Cotes, St. John's Well, Aghada, Cork and at other places, for people to try to discover by the floating or sinking of their shirt, whether one would recover or not. At their departure they usually hung a part of their shirt or a rag upon a bush near by as an offering.³ One form of oracular manifestation is seen in the ordeals such as those used in trial of witches, which survived until recent times. In 1759 King James I published his [in] famous treatise on demonology. One of the methods prescribed for testing witches and sorcerers was to find an anæsthetic or analgesic spot on the body of a person, which was an indication of league

¹ W. Robertson Smith: *Rel. of the Semites*, p. 162.

² Gabrielle M. Jacobs, in *Godey's Magazine*, Feb., 1898; see also Brand's *Popular Antiquities*, Vol. II, for interesting chapter on sacred wells and fountains.

³ W. G. Black: *Folk Medicine*, p. 73.

with the devil. The other was the trial by water. He wrote: "it appears that God hath appointed (for a supernatural sign of the monstros impiety of witches) that the water shall refuse to receive them in her bosom that have shaken off them the sacred waters of baptism and willfully refused the benefit thereof."¹ In Hadramant when a man was injured by enchantment, all the suspected witches were brought to the sea or a deep pool, weights were tied to them, and they were thrown into the water. Those who sank were adjudged immune, while those who did not sink were declared guilty, because the waters rejected them.²

In ancient religions it was criminal for persons ceremonially impure to approach sacred waters. Arabian women during menstrual periods were forbidden, for their children's sake, to bathe in the Dusares. At the present no one dares enter the valley of the Sheik Adi, which has a sacred fountain, without first ceremonial purification of person and clothing. Aristotle described a sacred oil-spring of the Carthaginians which would flow only for those ceremonially pure. Drinking certain water was often prescribed as an ordeal. The waters of Asbamæ, near Tyana, were sweet and beneficial to those who were truthful, but perjurers were at once afflicted with dropsy and wasting. Those who swore falsely by the Stygian waters died of dropsy within the year.³ The Hebrews prescribed the drinking of holy water for women suspected of infidelity to their husbands. The guilty were immediately afflicted with dropsy on drinking it.

Many superstitions are still current regarding the supernatural power of water to bring harm to offenders. Sayings and proverbs are also prevalent which, though not now believed, represent actual beliefs of more primitive times. One of the oldest superstitions regarded it as certain that ill would befall the rescuer of a drowning person. The older form of the superstition maintained that the rescuer would himself be drowned. In this primitive conception it was believed that the water was a spirit, or contained a spirit or nixy who was naturally angry at being deprived of his victim, and who would revenge himself by drowning the one who tried to thwart him.⁴

To dream of deep or muddy water is regarded as a sign of trouble. Dripping water is a sign of death. It is lucky to have rain fall on a corpse or an open coffin. To cross water cures disease. A stormy wedding day betokens a stormy life. Several in my syllabus returns speak of superstitions concerning water that have affected their own or others' actions. An old

¹ Quoted by Baros Sidis: *The Psych. of Suggestion*, pp. 336-7.

² W. Robertson Smith: *The Rel. of the Semites*, p. 163.

³ *Op. cit.*, pp. 163-4.

⁴ J. Fiske: *Myths and Mythmakers*, p. 215.

man going to the beach met a girl and happened to brush against her. He was drowned that day, and the girl was much frightened lest the same fate should befall her. She was heard to remark that she must be careful and not go out too far when she went bathing or she would surely drown. A man in Sweden besought his brother not to cross a certain lake because some one was sure to drown there within twenty-four hours.

F., 41. About a year ago I experienced a great trouble. The following day it rained very hard. Seemed as if nature were weeping with me.

F., 18. My mother and another lady both dreamed on three different nights that I was in my canoe and was drowned. At the time the "flood gates" at Park Island were in a dangerous condition. My mother and her friend were sure I would be drowned, but the gates have been repaired, and I am still alive.

Fishers folk are very superstitious, and regulate most of their lives according to superstitious beliefs connected with the sea. Birth and death are dominated by the ebb and flow of the tide. This is illustrated by Dickens¹ in referring to the death of Barkis. "People can't die along the coast," said Mr. Peggoty, 'except when the tide's pretty near out. They can't be born unless its pretty nigh in—not properly born, till flood. He's a goin' out with the tide. Its ebb at half arter three, slack water half-an-hour. If he lives till it turn, he'll hold his own till past the flood, and go out with the next tide,' . . . and it being low water he went out with the tide."

WATER DEITIES.

Folk-tales and mythology of all lands abound with accounts of spirits who inhabit the water. They are a product of the universal animistic conception of the primitive minds which, failing to differentiate the non-ego from the ego, personify whatever happens to be an object of contemplation. "To the lower tribes of man, sun and stars, trees and rivers, winds and clouds, become personal animate creatures, leading lives conformed to human or animal analogies, and performing their special functions in the universe, with the aid of limbs like beasts, or of artificial instruments like men."² Water with its ceaseless motion and constantly varying shapes offered wide scope for the savage imagination.

Proteus, the old man who tends the seal of Poseidon, lived near the river Aigyptos, and each day, when the heat was greatest, he raised himself from the deep and rested on the sea-

¹ David Copperfield: Gadshill Ed., Vol. II, p. 10.

² E. B. Tylor: Primitive Culture, I, p. 285.

shore. He first became fire, then a snake, and finally assumed many aspects before returning to his original shape. He is said to be the Farmer Weatherby of Norse tales. The daughters of Nereus are the Nereids or Naiads, denoting water dwellers. The word Nereid is usually applied to those living in the sea,¹ and the latter to those inhabiting fresh water. The Greek goddesses, Nymphê or Latin Lymphæ, belong to the water. Lymphaticus, of Latin origin, corresponding to Nympholeptos, denoted the man smitten by the Nymphs. The Nymphê were sometimes divided into the Oreads and Dryads. In the Vedas they are the Apsaras or movers in the waters, and are endowed with wisdom. Besides the Nymphê there were the swan-maidens of Aryan mythology, who were akin to clouds and vapors. They swam about on seas formed by the blue heavens, and navigated by the self-guided barks of the Phakians. Thetis, although called a Nereid, is akin to Proteus, and can change her form at will. Poseidon is lord of the Thalassa or troubled waters. Okeianos, whose slow-moving stream no storm can ruffle, dwells in the far west. He is the source of all things. "From him flow all rivers and all the tossing of floods, all fountains and all wells. He is, in short, the spring of all existence."² Neptune is not strictly a god of the sea, but "the god of the clouds as the source of all moisture and water."³ The Sirens are the witches of the shoals, while Scylla and Charybdis are the demons of the whirlpools. These are universally known, though under different names. Father Marquette met with the same belief among North American Indians with reference to a river whirlpool.

In Australia special water demons infest pools and bathing places. In the natives' theory of disease and death no personage is more prominent than the water spirit, who afflicts all who go into unlawful pools or bathe at unlawful times. The Greenlanders preserve animistic ideas concerning water. When they come to an untried spring an Angekok, or the oldest man, must drink first to free it from a harmful spirit. The Algonquin hunter says, "the spirit, he maketh this river flow." In all rivers, lakes or cascades, he believes there are spirits or mighty manitus. The Winnebagoes on reaching a body of water make a present or sacrifice to the spirits who reside there. The Peruvians used to scoop up a handful of water and drink it, praying the river deity to let them cross or to give them fish. Indians of the Cordilleras take a ceremonial sip before they will pass a river on horseback. Most African

¹ G. W. Cox : *Mythology and Folk Lore*, pp. 202-4.

² G. W. Cox : *op. cit.*, p. 204.

³ *Ibid.*

tribes display well the rites of water worship. Among the Manikas every spring has its spirit to which oblations are made. In the Okra district, lakes, ponds and rivers, are worshipped as local deities. The Kaffirs and Tartars venerate streams as personal beings, or as the abodes of personal deities. Water holds a very prominent position in Finnish mythology, and nothing in nature indicates a more supernatural origin. Many of the sayings are still beliefs. The people call themselves Suomilainen or fen-dwellers, since they live in a land of swamps and marshes. Vapor baths are a national characteristic. Many streams and lakes are called holy, and receive sacrificial tributes. They have a current superstition that rivers may resent being enslaved when a new mill is being constructed,¹ just as the Romans believed that the Tiber was offended when chained by a bridge. Their chief water-god, Ahto, lives with his cold and cruel-hearted spouse, Wellamo, at the bottom of the sea. The general term for inhabitants of the water is Ahtolaiset, which means water-people. Allotar is the wave-goddess, Koskenneiti the cataract maiden, Wellanos the eternal people or people of the foam and billows. In the Vedas the river is personified. Sometimes they are the good mothers who watch over and care for the people. They were believed to control the growth of vegetation and animals, and were addressed as gods who must be propitiated to retain good will.² Norse and Russian mythology are full of allusions of river-spirits. Matthew Arnold's Forsaken Merman is undoubtedly founded upon the Russian myth in which Russalka, the drowned girl, marries a Vodyany or Merman. The rivers of Russia are thought to have been persons. In Iceland seals are regarded as descendants of the Pharaohs who perished in the Red Sea.³ Thus we might trace the prevalence of water spirits in all countries,—in the remote Orient as well as the Occident.

Mr. Tylor says⁴ that to the savage mind "water acted not by laws of force, but by life and will; that the water spirits of primeval mythology are as souls which cause the water's rush and rest, its kindness and its cruelty; that lastly man finds, in the beings which can work him such weal and woe, deities with a wider influence over his life, deities to be feared and loved, to be prayed to and praised and propitiated with sacrificial gifts."

Paradise has usually been conceived by primitive people as a land beyond the sea, or a place surrounded by water, which must

¹ Max Müller: *Cont. to the Sci. of Myth.*, I, 269.

² Kalavala, the national Finnish epic.

³ W. R. S. Ralston: *The Songs of the Russian People*, p. 148.

⁴ *Primitive Culture*, II, 209.

be crossed at death. The belief in an earthly paradise existed for centuries. "The features of this earthly paradise are for the most part similar to those familiar to us in Biblical description. It contained the fountain of immortality, from which sprang the four rivers which flowed to the four quarters of the earth. Purling brooks ran with the far-famed ambrosia."¹ This garden of delight was often sought, but only those in league with the gods could find it. Nereus, the sea-god, succeeded in piloting Hercules to the spot.² A 14th century Icelandic saga describes the position of the Deathless Land as across a strait which was to be entered by a stone bridge, guarded by a dragon. In Japanese legend there exists an Island of Eternal Youth.³ It is beyond the horizon, and some fortunate observers have seen a wonderful tree rising far above the waves. The tradition was slow to die, and there are probably people who still believe, as did Sir John Maundeville in the 14th century, that the Garden of Eden exists somewhere upon the earth if it could only be found. After describing its cosmogenic position he relates that "in the highest place of Paradise, exactly in the middle, is a well that casts out four streams," the first is called the Ganges, the second the Nile, the third the Tigris, and the fourth the Euphrates. "And men beyond say that all the sweet waters of the world, above and beneath, take their beginning from the Well of Paradise, and out of that well the waters come and go."⁴

Rivers of Death. The "land of the blessed" is, as we have noted, quite universally separated from the abode of mortals by some body of water, now by a gulf, now the stormy sea, or again by a river which must be passed beyond the grave. The idea is preserved among all civilized people in sacred worship, by scripture and hymnology. The land of promise is quite universally across the "River of Jordan" or similar waters. Stories of "rivers of death" and "bridges of the dead" are to be met with in all tongues. The rivers Styx and Lethe have come down in our language as symbolic of death. There is a large quantity of Polynesian mythology relating to the gulf of death, though the bridge conception is lacking. Souls are obliged to cross this gulf in canoes or by swimming. In the ancient Orient the Vedic Yama, King of the Dead, crossed the rapid waters to guide our Aryan ancestors. The modern Hindoo is supposed to grasp the cow's tail when death comes, and is thus safely ferried over the dreaded river Vatarini. In ancient Egypt and modern Brittany Charon carried in his boat the

¹ Mrs. J. H. Philpot: *The Sacred Tree*, p. 136.

² *Loc. cit.*

³ *Op. cit.*, p. 141.

⁴ *Travels in Early Palestine*, p. 276.

procession of the dead to their long home. The ancient Scandinavians used to place their distinguished heroes in a ship, set it on fire and cast it afloat, or bury them in boats on shore.¹ The Finns, the Guinea Negroes, the Khonds of Orissa, and the Dyaks of Borneo, all have myths relating to rivers of death. Some North American Indians have tales of the bridge of the dead, but more frequently the water must be crossed in canoes to reach the "beautiful island." A storm always wrecks the wicked souls, and the heaps of their bones are to be seen under water as evidence of the fact. The Ojibwas are obliged to cross the Heaven Gulf on the way to the "land of spirits," and the wicked are drowned by their burden of sins.² Not even ghosts will cross living water. Witches, also, cannot do so, as we know in the case of Tam O'Shanter, they were baffled when he reached the Bridge o' Doon. Sometimes the milky-way and the rainbow are called the bridge of souls.³ That the soul after death has a perilous journey is believed by many people. The Algonquins believed that the wicked perished in crossing the lake to the happy land. The Choctaws are said to walk a peeled log, and the wicked slip off into the boiling gulf. The Moslem's bridge of Es-Sirat was sharper than a knife-edge. The Australian natives, who are without an idea of God, believe that their souls after death fly to the clouds or cross the ocean to a distant land. Finns believed that those journeying to Tuonella were required to voyage over nine seas and over one river, the Finnish Styx, black, deep, and filled with hungry whirlpools and angry waterfalls.

There is great tenacity in old impressions, especially when connected with the sanctity of religious doctrines and feelings. The primitive beliefs relating to the location of paradise, the river or gulf separating it from the present, and the difficulty of passing this water still survive in poetry and hymnology. From a few hymn books I have collected nearly two hundred different phrases and lines relating to rivers of life, fountains of life, healing waters, havens of rest, crossing wild and stormy billows, shore beyond the river, etc. (See sec. on Water in Literature.)

Many curious customs have arisen as a result of the belief in rivers of death. Various ways of aiding the departed on their journey have been invented. The custom of placing a coin in the hand of the corpse with which to pay the boatman who ferries them across the river is still found among Scandinavians, the peasants at Altmatkt, Germany, and among some

¹ John Fiske: *Myths and Mythmakers*, p. 49; also *Thalma*, by Marie Corelli.

² E. B. Tylor: *Early Hist. of Manhood*, p. 362.

³ John Fiske: *Myths and Mythmakers*, p. 57.

Irish at wakes, and among peasants in Cleveland, England. Some Hebrews in America are said to place a towel and soap with the corpse for use in crossing the river. In Brittany is the Baie des Ames (Bay of Souls), where souls are said to be launched for their voyage.

Water Itself Animate. Bearing in mind these early conceptions of primitive peoples regarding the supernatural powers and animation of water, it is not difficult to conceive how certain waters came to be sacred, while all folk-tales and mythology abound with accounts of waters of life, waters of strength, waters of weakness, etc. Nor will it be difficult to understand how by a slight extension of the idea of the supernatural power of living water came the conception of ceremonial renewal of life. Water was early ascribed as the dwelling-place of the gods, which is evidenced by survivals in the mythology of all countries. Mythology and folk-tales of all peoples abound with stories of nymphs, water-gods and goddesses, that reside in the waters. But evidence shows us that the more primitive conception regarded water itself as endowed with life. All nature suggests to the savage mind the conception of living force, and primarily supernatural life belongs to the objects themselves. W. Robertson Smith says of the Semites¹ "that the supernatural was conceived in a generally savage fashion, and identified with the quasi-human life ascribed to the various species of animals or plants, or even of inorganic things. For, indeed, certain phenomena of inorganic nature directly suggest to the primitive mind the idea of a living agent. . . . Of all inanimate things that which has the best marked supernatural associations among the Semites is flowing, or as the Hebrews say, 'living water.' In one of the oldest fragments of Hebrew poetry the fountain is addressed as a living being"² (Num. XXI, 17-18.) We have previously noticed that water was conceived among many primitive peoples as being the source of all life to vegetation, and was also supposed to possess the power of restoring the dead to future life. These ideas, coupled with the knowledge of the function played by drinking water and, also, the fact that bathing refreshes and invigorates, led naturally to the belief that water externally applied produces magical changes in human life. From these early beliefs and superstitions, the religious and legal ceremonial bathings, the precursor of later baptismal rites arose.

¹ Rel. of the Semites, p. 126.

² Rel. of the Semites, p. 127.

LUSTRATIONS AND CEREMONIAL PURIFICATIONS BY WATER.

Many writers ascribe to ceremonial purifications an origin purely purgative in character, but we shall see that the idea of a supernatural virtue inherent in the water is the most prominent and original feature instigating the ceremonies. The usual medium employed in lustrations is water, though sometimes other substances, as sand or salt, were used in default of water. But undoubtedly in these cases, also, the agent was believed to possess more than simple cleansing properties. Salt, we are certain, was regarded as sacred by many primitive peoples.

One writer¹ has suggested in accounting for the ceremonial of Christian baptism that John the Baptist simply utilized an observance largely in vogue in Oriental countries. This is undoubtedly true of Christian baptism, but the idea that ceremonial purifications, prior to this time, arose owing to the dust and heat making cleanliness and comfort demand very frequent bathing of the whole body, is not tenable. This custom may have been prevalent in that country, and in that advanced stage of civilization found by John the Baptist, but ceremonial purifications and lustrations date back to remoter times, and are found among the most primitive peoples of to-day. Though the idea of cleansing is found in some or perhaps most of the ceremonials, yet many circumstances indicate other ideas connected with their origin. Certainly the idea of bodily cleansing is very remote among some of the most ardent disciples. Tylor states² that "these ceremonial practices have come to mean something distinct from mere cleanliness. Kaffirs who will purify themselves from *ceremonial* uncleanness by washing, are not in the habit of washing themselves or their vessels for ordinary purposes, and the dogs and the cockroaches divide between them the duty of cleaning out the milk baskets.

I believe, however, that instead of "coming to mean" as Dr. Tylor interprets it, that the ceremonials always have been only partially indicative of either literally cleansing bodily uncleanness or symbolizing purification from spiritual contamination. This meaning has been read into the facts in the light of modern baptism. But the older idea considered that the fetish could in some magic way renew, revive, rejuvenate, or even remove undesirable qualities. There was a belief in some inherent sacredness and magic power of the medium itself with little or no thought of the literal cleansing properties. From time immemorial the Ganges has been held sacred. Whoever bathed in it was cleansed and rejuvenated. The new-born babe

¹ A. W. Eaton: Heart of the Creeds, p. 135.

² Primitive Culture, p. 434.

is bathed in it, the sick sprinkled with its water, and the dead are plunged into it. It is carried to the Hindu houses and used in the temples. Now, were water symbolic of cleansing, only, any water would suffice. But it must be particular water, possessed of supernatural powers.

According to the legendary lore of the Greeks at the feast of Pales, the goddess of the flocks, shepherds purified themselves by washing in fresh dew, or by aspersion with consecrated water, sprinkled from a laurel or an olive branch.¹ The Scriptures record that 804 years B. C., Naaman was sent by Elisha to wash in the Jordan seven times to be cured of leprosy. After dipping himself seven times he came forth clean, with flesh like a little child. All these illustrate how, from the more primitive belief in the universal life-giving power of water, certain waters became set apart as sacred, and still possessed of curative powers and revivification. The symbolism of spiritual cleansing is plainly a later idea. The myths and legends of fountains of youth, waters of immortality, and later facts relating to sacred wells, rivers, etc., elsewhere described, corroborate this view.

Among all peoples ceremonial lustrations have been practiced long before baptismal rites, symbolic of spiritual cleansing were known. Long before the Christian era ceremonial purifications by water were common, and are also common among savage tribes at the present time who know nothing of baptism. Some savage tribes, it is true, know and practice baptism which they have learned from missionaries, but lustrations were known to them before the ceremony of baptism was learned. Sacred² and profane literature record that ceremonial purifications were to be observed after such occurrences as childbirth, theft, touching a corpse, adultery, the conjugal act, etc. Lustral water was placed at the doors of the Greek temples so that priests could purify the profane. Usually before entering a temple the hands and feet were washed. This was also true among the Hebrews.³ The Hebrews were taught to regard running water as having greater power of purification than still water. The Incas of Peru to be purified from guilt bathed in the river and repeated the following: "O, thou River, receive the sins I have this day confessed unto the sun; carry them down to the sea, and let them never more appear."⁴

Among the Essenes and the Pharisees ceremonial bathing took up a great part of the time, so that it was very natural that John the Baptist should adopt that method of consecration in

¹ Baring Gould : *Origin and Derivation of Rel. Belief*, p. 398.

² Lev. XII, XV, etc.

³ Ex. X, 29, 30, 40; Lev. 8, etc.

⁴ Baring Gould : *Origin and Deriv. of Rel. Belief*, pp. 399-401.

Christ's time. It was simply making sacred a custom which had long been in vogue.

Infant Baptism. The lustration ceremonials for infants, prevalent among almost all primitive peoples, contain many suggestions that indicate belief in the magic power of water. In many cases these infant baptisms, as well as some of the ceremonials above noted, are for the purpose of removing *tapu* or *taboo* as well as cleansing. Among many tribes a new-born infant is taboo until ceremonial purification has removed the taboo. Some tribes do not baptize the infants until three or four months old. During this period the mother is also taboo. This does not refer to uncleanness in the ordinary sense of the term. The taboo may refer in some cases to physical uncleanness, but the more primitive conception is that the object of taboo is in some mysterious manner associated with dangers arising from the presence of supernatural spirits, which are to be avoided as one would avoid infectious diseases. All taboos are produced through awe of the supernatural. The new-born, as the woman in childbed, or during her courses, or the person who touches a corpse, are all taboo because everything connected with generation of the species, and also with disease and death seem to involve supernatural powers of a dangerous sort. There is a type of taboo arising out of respect to the gods, where certain holy things must not be touched, but it is not because of the offense given. On the contrary, it is because the taboo will sanctify whatever it touches, rendering it unfit for ordinary uses. For example, "a slave or other person not sacred would not enter a *wahi tapu*, or sacred place, without having first stripped off his clothes; for the clothes, having become sacred the instant the precincts of the *wahi tapu*, would ever after be useless to him in the ordinary business of life."¹ "The fundamental notion," says Smith, is that the tabooed object "is merely not safe for ordinary people to use; it has, so to speak, been touched by the infection of holiness, and so becomes a new source of supernatural danger."²

In higher stages of thought the idea approaches the popular notion that the unclean object has become hateful to God, and should be shunned by all who wish his favor. But according to the more primitive and fundamental notion, holiness was contagious, and things that came in contact with such taboo needed purification just as much as distinctly corrupted objects.³ To show that unclean things are tabooed because of the inherent supernatural condition supposed to be connected

¹ W. R. Smith: *Rel. of the Semites*, p. 432. Quoted from Shortland's *N. Zealand*.

² *Op. cit.*, p. 431.

³ W. R. Smith: *Rel. of the Semites*, p. 431; also Isaiah LXV, 5.

with it, it is known that some of the most tabooed things, as menstruous blood, bones of the dead, etc., are the most potent charms. According to Mr. Smith, "the heathen Arabs used to tie unclean things, dead men's bones, menstruous rags, upon children to keep away the *jinn* and the evil eye."¹

"Primarily purification means the application to the person of some medium which removes a taboo and enables the person to mingle freely in the ordinary life of his fellows. . . . Purifications, therefore, are performed by the use of any of the physical means that re-establish normal relations with the deity and the congregation of his worshippers—in short, by contact with something that contains and can impart a divine virtue. For ordinary purposes the use of living water may suffice, for, as we know, there is a sacred principle in such water."² Blood, also, in its most primitive sacrificial idea was not used to wash away impurities, but to carry to the worshipper something of holy life. The idea of expulsion of an impurity is perhaps involved with the adding of sanctity. The evil may be dispossessed by inoculation with a more desirable life. This idea is seen in the Catholic Church in the exorcism of devils from the catechumen before baptism.³

In southern Egypt the child is bathed for the first time on the 40th day. From that time on it is no longer taboo, but pure. The same custom is chronicled of many primitive peoples, *e. g.*, the Aryans, Turanians, Polynesians, Semites, certain tribes in the Canary Islands, some Negroes and Indians. Long before the Christian era among the Norwegian Lapps, a Finnish people, infant baptism was a national custom. At the time of the ceremony the child was given a name and consecrated to a good, lucky and prosperous life. After every disease this ceremony was repeated and the child received a new name. This probably symbolized a new birth, received through the sacred potency of water, after which the child lost its old name and identity, and consequently could no longer be found by the evil spirits. New Zealanders baptize the child when eight days old. All the women of the neighborhood dip branches in water and sprinkle the child. At the end of a month the child receives a second name and a new baptism. The Tohunga (priest) dips a green twig into water and sprinkles the child, at the same time repeating his blessing in such ancient language that few understand it. This would indicate its remote origin. In the northern part of New Zealand the child is

¹ *Op. cit.*, p. 429.

² W. R. Smith: *Rel. of the Semites*, pp. 405-6.

³ *Op. cit.*, pp. 406-7. For a general discussion of some of these topics see same work, *Taboos*, p. 143, *et seq.*; *Sacrifice*, p. 405, *et seq.*, *Note C*, p. 432.

dipped. The Papuans bathe (ceremonially perhaps) the child as soon as it can walk, when it receives a name. This is repeated several times. Many tribes do not bathe the child at all for months. The Uveans of the South Sea sprinkle the head of the child, and, like most primitive peoples, make the first bath of the child an occasion of festivity. In Java the child's head is shorn on the 40th day, and it is plunged into the river. Among the Battas the neighbor women await the birth of the child, which is immediately carried to the men, who take it to the nearest stream, give it a dip, while the father gives it a name. The Fiote Negroes baptized at three or four months, the child being dipped and sprinkled by all the community and given a name. The Basuto Negroes cook up some magic decoction and sprinkle the child with this. Upon the birth of a child among the Yoruba's of western Africa they send for the priest and ask for the name of some dead ancestor who intends to re-inhabit the child's body. They look upon this as a rebirth of the soul. They baptize and sprinkle the child's eyes with sacred water. In the lowlands of Scotland a new-born babe was bathed in salt water and made to taste it three times. The solution was considered strengthening to the child, and also obnoxious to the evil eye.

All these ceremonial lustrations indicate the widespread belief in the regenerating and life-giving power of water, and also its efficacy in removing taboo, so that the child could enter into harmonious relations with its new existence. Although I shall not enter into the subject of Christian baptism, we can easily recognize the older materialistic conception in the symbolism of spiritual regeneration which water holds in Christian baptism to-day.

WATER IN LITERATURE.

Space will permit only the briefest mention of the great influence that water has had upon literary expression. Poetry has kept alive the old animistic theory of nature. The poets, like children, are deeply animistic, and their expressions reflect the closeness with which they keep in touch with nature. Poetry is largely a conventionalization of child-like ideas. To quote Dr. Tylor there are moments in the civilized man's life when "he casts off hard, dull science and returns to childhood's fancy, [and] the world-old book of animated nature is open to him anew. Then the well-worn thoughts come back to him, of the stream's life that is so like his own; once more he can hear the rill leap down the hillside like a child, to wander playing among the flowers; or can follow it as, grown to a river, it rushes through a mountain gorge, henceforth in sluggish strength to carry heavy burdens across the plains.

In all that water does, the poet's fancy can discern the personality of life. It gives fish to the fisher, and crops to the husbandman; it swells in fury and lays waste the land; it grips the bather with chill and cramp, and holds with inexorable grasp its drowning victim."¹ Hence it is only a natural expression of animistic feelings to say

"The bubbling brook doth leap when I come by,
Because my feet find measure with its call."

Or with Michael Bruce in Lochleven that

"The vales, the vocal hills,
The woods, the waters, and the heart of man,
Send forth a general song."

And with Joseph Warton, who added—

"And that all nature conspires to
Raise, to soothe, to harmonize the mind."

The ocean has always impressed the poets strongly. Barry Cornwall's characterization of the ocean expresses the sentiments of many.²

"O, thou vast Ocean! ever-sounding Sea!
Thou symbol of a drear immensity!
Thou thing that windest round the world
Like a huge animal, which downward hurled
From the black clouds, lies weltering and alone,
Lashing and writhing till its strength be gone.
Thy voice is like the thunder, and thy sleep
Is a giant's slumber, loud and deep.
. . . . Oh! wonderful thou art, great element;
And fearful in thy spleeny humours bent,
And lovely in repose; thy summer form
Is beautiful, and when thy silver waves
Make music in earth's dark and winding caves,
I love to wander on thy pebbly beach,
Marking the sunlight at the evening hour,
And hearken to the thoughts thy waters teach—
Eternity—Eternity—and Power!"

The same writer says of the streamlet:³

"Gently it murmurs by
The village churchyard, its low plaintive tone,
A dirge-like melody,
For worth and beauty modest as its own
May not its course express,
In characters which they who run may read,
The charms of gentleness,
Were but its still small voice allowed to plead?"

¹ E. B. Tylor: *Primitive Culture*, II, p. 209.

² *Address to the Ocean*.

³ *The Cataract and the Streamlet*.

The poet Swinburne calls the sea "fair, white mother," "green girdled mother," "great, sweet mother," "mother and lover of men, the sea."¹

James Russell Lowell regards the fountain as typifying great happiness.

"Into the starlight, Rushing in Spring,
Happy at Midnight, Happy by day!
. . . . Ceaseless aspiring, ceaseless content,
Darkness or sunshine, thy element :—
Glorious fountain! Let my heart be
Fresh, changeful, constant, upward like thee!"

— *The Fountain.*

Dr. Biese² says of the peculiar charm of one of Goethe's scenes in *Faust*: "Die Herrliche Sommerabend-scene liegt im Keime mit den Worten: Ach demals, wie oft habe ich mich mit Fittigen eines Kranichs, der Ufer des ungemessenes Meeres geseht, aus den schäumenden Becher des Unendlichen jene schnellende Lebenswärme zu trinken und nur einen Augenblick in der eingeschränkten Kraft meines Busens einen Tropfen der Seligkeit des Wesens zufühlen, das alles in sich und durch sich hervorbringt." Again he quotes Pindar as saying:

"Des Menschenseele gleicht dem Wasser:
Vom Himmel Kommt es zum Himmel steigt es,
Und weider nieder zur Erde Muss es ewig wechselnd."³

Dryden's writings are full of references to water.

Miss Reynolds says,⁴ as illustrative of Dryden's use of similitudes drawn from water, note the following: "Revenge and rage are sudden floods; joys are torrents that overflow all banks; contending passions are tides that flow against currents; fame is a swelling current; anger is a dammed-up stream that gets new force by opposition; a ruined life, destroyed fortunes are shipwrecks; love is like springtides, full and high, or like a flood that bursts thro' all dams, or like a stream that cannot return to its fountain, or like the tides that do not turn; the disappointed lover dies like an unfed stream; the mind of a capricious tyrant is like a vast sea, open to every wind that blows; the army of the enemy comes like the wind broke loose upon the main; an obdurate foe is as deaf to supplication as seas and wind to sinking mariners; an open mind is a crystal brook; grief undermines the soul as banks are sapped away by streams; the voice of a mob is like winds that roar in pursuit

¹ See Dr. Chamberlain's *Child and Childhood in Folk Lore*, p. 39.

² Alfred Biese: *Naturgefühls*, p. 385.

³ Alfred Biese: *Naturgefühls*, p. 390.

⁴ Myra Reynolds: *Treatment of Nature in Eng. Poetry*, pp. 28-9.

of flying waves; unspeakable anger is like water choking up the narrow vent of the vessel from which it is poured; and so on through a long list."

Religious rites and ceremonies are great conservators of ancient thoughts and customs. In hymnology we find innumerable metaphorical expressions of former literal beliefs. From a very few books I have collected nearly two hundred such verses, of which the following are typical:

- "Behold I freely give, The living water, thirsty one,
Stoop down and drink and live."
- "When death's cold, sullen stream
Shall o'er me roll."
- "Safe into the haven guide. . . ."
- "Bear me o'er life's fitful sea."
- "Till I reach the golden strand,
Just beyond the river."
- "There's a precious fountain,
Free to all a healing stream."
- "Foul, I to the fountain fly."

FEELINGS OF PEOPLE AT PRESENT TOWARD WATER.

In the light of the preceding investigation let us consider the reactions of people toward water at the present. To carry out this study a syllabus (M. XV, Water Psychoses) was issued in February of the present year. Only a part of the list of questions contained in the syllabus have been considered in this paper. To some others the returns were too meagre to furnish any important data; others may be worked up in a subsequent paper. About 800 individual papers, some covering as many as 20 pages of letter paper have been considered in this report.¹

Feelings Toward Water in General. Many like to be near water, and to watch it because it makes them feel happy, or because it has a "soothing effect." Some have "feelings of reverence such as they feel nowhere else, and they wish to be noble and pure." To some it "seems like a friend," "a great comfort," others "feel like confiding to it their sad thoughts."

¹ I am under great obligations to the following persons who furnished large numbers of returns from their pupils: Professor Will S. Munroe, State Normal School, Westfield, Mass.; Professor Lillie A. Williams, State Normal School, Trenton, N. J.; Professor E. J. Swift, State Normal School, Stevens Point, Wis.; Principal E. M. Beaman, Fairchild, Wis.; Principal E. H. Cassels, Tomah, Wis.; Superintendent R. B. Dudgeon, Madison, Wis.; Principal E. L. Bolton, Tunnel City, Wis.; Principal Sarah E. Davies, Atlanta, Ga.; Miss S. Elizabeth Smith, Kaukauna, Wis.; Superintendent J. M. Barrow, Columbus, Miss. To the various assistant teachers, all the pupils, and those who sent individual returns, my obligations are also gratefully acknowledged.

Various reasons are given for liking it, such as: "it is so musical," "it affords such a variety of amusement," "so restful," "have natural instinct for it," "love it because it attracts me," "seems like human beings," "seems to soothe me," "seems to sympathize with me," "because it goes on its journey as a man does, sometimes placid, sometimes turbulent," etc.

The *time of day* and the state of the weather exercise a strong influence over the feelings. Bright, pleasant days bring feelings of "unutterable peace," "happy recollections," "joyousness," etc. When bright and windy some record feelings of "passionate joy, difficult to analyze because of their very intensity." To be near water in cloudy weather "makes me moody," "profoundly melancholy," etc. In the morning or at sunset a "keen delight" is felt. At dusk or in the moonlight "feelings of awe, wonder, sadness," "desire to be alone and not to be spoken to," "solemnity," etc. One records that if sky is dark and wind high "I feel as if I *must* let the water carry me somewhere—it matters not where, but somewhere away from myself."

Storms produce various effects. Some fear them, but more enjoy them, especially if they are used to being near water. Expressions concerning them are variously given, as: "the roaring and the rocking are pleasurable," "something about the vast amount of water with its easy, uncontrollable motion, ever changing, yet repeating the same forms that makes me exultant in its power," "was filled with the beauty and might of the waves," "one word, grandeur," "felt as though could scarcely breathe," "always feel as if water were alive and sending out its arms for prey," "seems like a great monster which would not hesitate to wreak its vengeance upon anything within its reach," "the rougher the sea the better I like it," etc.

Running water seems to produce a different effect from large expanses. As was noted elsewhere the Jews held running or living water in especial reverence. Small streams bring "a sort of dreamy, happy feeling," "an inward pleasure and happiness and excite to more vigorous action," "relief from sadness and reveries are of pleasant things," feelings of "jollity and fun." Brooks to many seem possessed of life—"like children, happy and gay," while rivers "typify greater maturity and exhibit purposeful action." Many record that they often steal away from all persons just to sit by a stream and watch it and listen to its music. They sit and meditate "upon the works of God." The beauties of ripples, eddies, color, its swiftness, its music, its majesty, all seem subjects for a poet's theme. One says that she "often fits words of poetry to the tune made by the rippling brook." A little girl of 5 said

brooks "must lead charmed lives, now flowing in the bright sunlight, babbling over the pebbles, now running through some quiet wood, where only the rustling of the leaves or the chirps of the birds disturb them."

Large expanses produce a quite different class of feelings. Such expressions as the following are very numerous: When viewing large expanses "I feel insignificant, stricken with awe, as though the supernatural were in the water," "makes me happy, contented, yet restless," "uncontrollable feelings of longing and half sadness," "sorrowful, especially if alone," "should like to be as pure as they are," "wish to always watch and never leave," "always loved the grand old ocean, and ever shall," "feelings less personal than when near small bodies, thoughts of a universal interest, of the God of the universe and of nature, rather than of a personal God," "enrap- tures me so I cannot help exclaiming at the grand spectacle," "awes me with its mightiness," "sad feelings increased," "desire to get to the place called the horizon," "wish to sail far away and explore unknown depths," "feelings of awe, reverence and solemnity," "it reveals nature's vastness and my own insignificance," "seems as if gazing into eternity," "feelings of sublimity; the absorption of my soul into the universal soul," "produce a yearning toward one far off divine event to which the whole creation moves," "Nothing so fair; so pure and at the same time so large, as a lake, perchance, lies on the surface of the earth," (Thoreau) "feel utterly powerless in its presence," "suggests power, deep thought, ability to keep grave responsibilities secret; representative of great persons, their silent yet powerful actions, compels me to submit to nature's plan and to realize that all its workings are in more perfect harmony than those of any individual."

Waves, billows, etc., are always objects of especial interest because of the activity and force displayed. The following expressions are typical: "make me feel as nothing compared with them," "ripples make me feel jealous; sometimes think of them as the laughter of children," "waves seem to be at play," "through waves nature displays her mighty power," "seem like great, lifeless monsters, moved by a mighty hidden force," "produce delight and admiration for their grandeur and beauty," "ripples make me think of our deeds,—sometimes good, sometimes bad; waves of our sorrows and joys,—how they swell and swell until they can grow no more, then suddenly burst," "remind me of waters of time, pessimists, shallow-minded men, unable to accomplish ends without friction; brute force instead of persuasion, selfishness, treachery."

To be on the water intensifies many of the emotions experienced when only looking upon the water.

The vastness of the universe, the power, beauty and grandeur of nature's hidden forces, the insignificance of individuals, the oneness of nature, the strength of the ties of kinship and friendships, the awful solemnity of being alone with nature probably never can be so forcibly realized as when in mid-ocean during a midnight storm. Brave hearts quake with fear, stalwart forms tremble, the pious and the blasphemous seek comfort and protection in prayer; all feel that the power of God is manifest and that his creatures must bow before his will.

When on the water "I feel nature's vastness and my own insignificance," "whenever alone with nature I feel how grand it is and how insignificant I am, but when on the water the feeling is much stronger," "have feelings of solemnity and think how soon the waves could swallow me up," "feel solemnity and reverence for God; that I am a part of this great world and that I have my duty to perform in making it beautiful," "in a boat I always feel caged," "have joyousness, solemnity, reverence, awe, and humility, but never real sadness."

Children's Animistic Conceptions of Water. The next three rubrics deal with the animistic conceptions of water which children have. We find that most of the answers are from children or are reminiscent experiences of older persons which refer to child life. The child, like the savage, conceives all nature endowed with life and it is only later at the approach of adolescent years and the dawning of self-consciousness that the differentiation between himself and surrounding nature becomes complete. Most children regard water, and in fact all nature, as endowed with life. Some ascribe to it animal life, others human life, and many talk to it. With few exceptions they think of it as talking but many do not think they can understand it. The older ones think of its animation in a more metaphorical way and not with the reality of childhood. In these childish expressions so frankly and candidly given we have the pages of the earliest stages of man's life opened to view. The savage heard the voice of nature talk to him with tongues understood only by the primitive mind; the child recapitulating the race history understands those same voices. The poet, like the child and the savage, penetrates what is invisible to ordinary mortals, and is cognizant of the same unseen powers. These he discloses to us through his versifications. To the ordinary mind these voices become hushed through the complex of psychic influences necessary to mature existence.

Water as Endowed with Life. 1. F., 12. Often think the water has wild life like animals.

2. M., 12. Think of it as a person; it seems as if it could talk.

3. F., 15. Seems as if it had life like a roaring lion.
 4. F., 13. Appears to be planning to do some wrong.
 5. F., 17. The noise of the ocean and of rapids give me a feeling that they have life.
 6. F., 17. Never talk to water. It seems to have life but not like animals or persons; it gives one a different feeling.
 7. F., 15. When it attempts to drown me I think it has life.
 8. F., 14. The waves seem like snakes.
 9. M., 14. The waves make me think they are coming to catch me.
 10. F., 17. Billows, eddies, ripples seem endowed with life. They seem to think then act. Often think of the waves as temptations.
 11. M., 12. Think of the water as being kind of snaky.
 12. M., 18. Reared in the country and always thought of the water as being somewhat of a friend to me.
 13. F., 14. Seems alive; don't know what kind of life, but the waves seem to be groaning.
 14. F., 18. Used to think it had life, but different from ours; it was always a puzzle to me.
 15. F., 17. Used to think it had life like a person and was made to take care of little children.
 16. F., 20. When small thought it had work to do, and that it hurried along so fast because it had n't time to stop.
 17. F., 17. Used to imagine the water had life; knew that it really had n't, but liked to think it had and that it was like a person.
 18. M., 18. When a child, frequently thought it had life and was talking as it rippled over its stony bed.
 19. F., 19. In a storm the waves and billows dash against one another and crowd and jostle each other as though their bed was too small for them.
 20. M., 13. Think of water having life like a person.
 21. F., 9. Seems alive, so human.
 22. M., 12. Think it is like animals because so wild.
 23. F., 11. Think of it having life like an intelligent animal.
 24. M., 11. Think it like a person, because it is so bright and knows how to work.
 25. F., 30. I am happier in the instinctive feeling that water has a kinship of life with me, than when I am under the rebuke of reason concerning such things.
- Talk to Water.* 1. M., 18. When small, I sometimes talked to water and asked it if it would be good and not wash away my water wheels.
2. F., 5½. Was sailing a boat; the string broke and the boat went sailing away. She said, "Water, if you don't bring back that boat I'll tell mamma." Another time was heard to say to the brook, "I wonder where you go to? Do you ever get tired? I know I should." She says water must have life or it could n't move. Thinks it feeds on grass and sticks. Thinks rivers and brooks talk, but she cannot understand what they say. Thinks it must be saying, "How happy I am! Nothing to do but play all day."
 3. F., 20. Used to scold when the ocean washed my sand houses away, calling it "a mean old thing!" After building them up again, I would say, "Come on now and enjoy it!"
 4. F., 12. Have talked to it in my mind, if not in words, many times and said I would like to plunge into it.
 5. F., 15. I talk to it as if it were a person I love very much and tell it all my little troubles.
 6. F., 41. As a child I said, "Pretty water, I like you. Where are you going? Take me with you."
 7. M., 19. Never talked to water, but always recited a certain piece of poetry when near the shore.

8. F., 17. Used to ask the ocean to tell me what it saw way out from land and to tell me about the little girls it saw.

9. F., 18. Used to sympathize with water when rocks or stones were in its way, and would scold the stones and talk pityingly to the water.

10. F., 22. When watching waves chasing each other I have said to the one I wished to beat, "Oh, hurry, hurry!" Used to draw a line before my sand houses and say, "Now, you must n't come any further." When the houses were washed away, I said, "Horrid thing!"

11. F., 6. Scolded the river after a boy had been drowned. To punish it would not go near it for a week. When did go, thought the river was glad to see her.

12. F., 11. Never talked to it, but have often thought I should like to.

13. F., 10. Sometimes like to talk to it. Was sitting beside it and told it it made me feel cool and that I loved its little rippling music.

14. F., 18. Used to say, "Pretty, babbling brook, singing, laughing brook!"

The following paragraph gives some expressions that children think the water seems to use:

F., 10. "Ripple, ripple, ripple." M., 10. "Flip, flap, flip, flap." F., 12. "I am tired of running so long." M., 12. "For men may come, and men may go, but I go on forever." M., 13. "Come." M., 10. "I chatter over stony ways." M., 12. "Bubble, bubble, bubble." F., 13. "Come, bathe in this nice, warm water." F., 13. "Come along, we have no time to play." M., 12. "Roll on, roll on." M., 15. "I will swallow you up." F., 12. "Hiawatha, Wa-wa Tasi." M., 16. "Don't get near me or I'll take you out with me." M., 11. "Come, jump in." M., 13. "Won't you come in and have a swim." M., 14. "Let me get hold of you and I will swallow you up." F., 14. "I am stronger than you are." M., 11. "I am on my way to the ocean." M., 12. "I go on forever." M., 12. "I'm coming on through hills and vales and over stones to meet the ocean." M., 16. "Keep away from me. I'll drown you if I get the chance." F., 3½. After wading in the brook, told that the water said, "Oh, stay a little longer! Come along with me, I'll catch you." M., 10. "Trick, trick, trick." F., 11. "What part of you, little river, is the widest? and what kind of fish are swimming about in the water?" M., 10. "I would like to know your history and about your drifting ships." F., 12. "Have you had a pleasant journey? Do you expect to carry large ships?"

Water seems to be talking. 1. M., 12. Think it the most delightful thing to be near water, to watch it flow, and hear it tell of its wonderful adventures.

2. F., 15. I think the water seems to talk; it sounds like some sweet lullaby.

3. F., 18. In running it seems to be talking all the while.

4. M., 20. As a child, when playing in streams, I imagined the ripples sang, "Go home, go home!"

5. F., 18. The waterfalls seemed to laugh, but when dashing against the rocks I used to think it scolded because rocks were in the way.

6. F., 17. Thought the water answered what I said but thought I was too little to understand, but would when I grew older.

7. F., 41. It seemed to say it was very busy rushing on to the sea.

8. F., 20. Its music I hear, but it is a music entirely different to

my imagination from that of any human music—a music of nature, separate and distinct, as is also the wind's.

9. F., 17. At the beach the water used to seem to say, "Come on down, little girl, I love you." Once when I had ventured too far and my clothes became wet, I told my mother the waters had told me to come down and they would n't hurt me.

10. M., 12. Seems to be complaining, especially when there are rocks in a creek. Seems to be moaning when the tide comes in.

11. F., 19. When I first heard the ocean waves (at 13) I imagined they were saying something to us which we did not understand. Sometimes I thought them singing mournful songs. Always thought the waves were like queer people. Just as we were the inhabitants of the earth, they were of the water.

12. M., 10. Seems to say: "I have lived a hundred years and more, have fish, whales, snakes, and many other things."

13. F., 11. Seems to laugh on days when the sun is bright and moan sadly on a dark day.

14. F., 11. Think it talks, because trees talk. Think by their moaning they comfort the fish.

15. M., 12. It talks. Don't know what it says, but *it* knows.

16. F., 11. The largest bodies seem to talk and tell you great stories.

17. M., 13. Seems to be talking but not a language like ours; has a language of its own.

18. F., 11. Says "I work," and many other things.

19. M., 11. Some water seems to say "Follow me, follow me."

20. F., 10. Sometimes seems to tell me to bathe in it and it will refresh me. Also tells me of the journeys it takes.

21. M., 11. Seems to say "Come in and play, come in and play."

22. F., 17. Water was always talking to me, telling me of its little scrapes and trials and the fun it had.

Earliest Feelings toward Water. The general concensus of testimony relating to babies' actions on being first placed in tub baths, is that the water causes momentary fright when it first comes in contact with the skin. Almost without exception the verdict is that after the first shock and surprise are over babies take extreme delight in being in the water. This they manifest in various baby ways—by splashing about, by cooing and prattling, smiling and laughing, and by remonstrating against being taken out. After a few times at most the bath becomes a pleasurable event, and is looked forward to with keen delight. Of course, some exceptions are recorded, but they are very few indeed. When a little older, children often object to having their faces washed, but many reminiscent items indicate (although this question was not asked) that it is because children feel that it is a waste of legitimate playtime, and is not because of any objection to the water. The following answers are typical of great numbers received:

1. F. Mother says the first time I was put into a tub of water I did n't make a sound, but clenched my hands and stiffened my body.

2. An experienced nurse said most babies objected to their first bath, but usually changed.

3. F. Mother says when I was a baby I loved water and was still as a mouse when she washed me.

4. M., 7 mo. When put into the bath kicks and squeals with delight, but cries when his mother takes him out.
5. F. Mother says I enjoyed tub baths very much, and liked to play in the water.
6. F. Mamma says I used to jump for joy when she mentioned the word water.
7. M. Mother says at sight of water I used to want to jump right in.
8. F., 12. When about $1\frac{1}{2}$ -2 yrs. old, one washing-day, I was all dressed to go out, bonnet and coat on, I climbed upon the chairs and got right into the tub with all my clothes on. Did n't mean to be naughty: was always a good child, but it was because I liked water. (A little boy did the same thing.)
9. F., 14. When small was afraid of water. Thought only fish could stay in it.
10. M., 14. Have always loved to be in the water. Remember the first time put into a tub—was about a year old.
11. F., 17. As a child liked to paddle and wade in water because I liked the feel of it.
12. F., 18. When a child was very fond of being near water, but was always afraid of reptiles. Think all children like to play in water.
13. F., 23. Did not like to bathe when a child, but it was because of the cold when they took me out.
14. F., 10. Like to paddle and wade in water. Enjoy bathing but shudder at coldness. Earliest fears of water were because afraid of drowning.
15. F., 17. When a child loved it. Seemed to be my dearest play-mate.
16. F., 20. Most enjoyable hours of my childhood were when we children went to the woodland brook to wade.
17. F., 14. Earliest recollections were of seeing some persons immersed, and I shouted "See them going into the pretty water."
18. F., 20. When about 12 loved to ride on rafts so well that I tried to construct one myself.
19. F., 17. When a child, during a storm at sea, would run away and just stand and watch it for hours from the shore. Never wanted to talk to any one. When all others were frightened, I was delighted. My love for the ocean is almost a passion: would rather be near it than anywhere else in the world.
20. F. Thought when water was happy it danced along in the sunshine, and when it was sad it was still. I was then sad, too.
21. F., 20. As a child loved small streams and always longed to lie down on the grassy banks and gaze upon the water as it danced along.
22. F., 18. Was fond of playing in puddles. Am told I used to sit under our old pump and pump water over myself.
23. F., 17. When I see streams always want to put my hand into the water.
24. F., 18. Was always running out in the rain and running away to the brook, where found, minus shoes and stockings, paddling around in the water.
25. F., 22. Many times when a child I ran away to go and play in the water. Had to be watched continually. Three times I ran away to the docks, fell off, and was nearly drowned each time, but all this did not frighten me away.
26. M., 7. So fond of the water almost impossible to keep him away from it. Would go swimming in deepest part of the brook as often as he could without his mother knowing.
27. F., 17. Earliest love for water was when very small. Father

took me in bathing and swam way out, while I was perched "piggie back" fashion. Thought it the nicest thing a little girl could do.

28. F., 20. At 3 my parents had hard time to keep me out of the water. After being dressed for the afternoon would wander to the stream to watch the boys fish and swim. Parents always knew where to find me.

29. M., 7-8. Always preferred companionship of water to children. Often begged to have a lunch and go and stay all day, returning only when sought. When he returned to the city would pine for the sea-shore and seemed to live only for the next summer. Was a different child when away from water.

30. F., 15. Likes water so well that when washing dishes she plays and dabbles in the water. Seems pleased and generally sings. (In one way, exceptional.)

31. M., 7. Forbidden to go near the water, but used to manage to go almost every day and remain in by the hour. In spite of all punishments this transgression continued.

32. F., 23. When 5 went to beach. Saw the waves and screamed with fright. Would not go in nor allow my mother to. She picked me up and in spite of myself carried me in. Soon liked and do yet.

33. F., 11. Loved the water in the river when I first went to bathe. Was very anxious to get into it.

34. F., 11. Like to paddle in it because I like to see the water splash.

35. F., 13. Like to wade and go as far out as I can without getting my clothes wet.

36. M., 12. Like to bathe in all kinds of water.

37. F., 11. Like to ride on planks and rafts because it has such a good feeling and is such fun.

38. M., 12. Love the water like a fish; don't know any boy who does n't.

39. M., 11. Like to wade and paddle because I like to get wet.

40. F., 14. Don't know of any one who does n't like to wade and paddle. Children think it a great loss if near the water and cannot go in.

41. M., 13. Like to ride on planks, and when way out in the river we push each other off to get a good ducking.

42. M., 10. Would often conceal his books underneath the piazza, and generally go to the water.

43. Was out with a boy of 7 in one of worst storms of sleet, and yielded to his coaxing to sail chips down the gutter. It was the noon hour and he forgot his dinner. Soon many little boys joined. Do not believe one of those boys would have willingly forsaken that fun for the best dinner that ever tempted a child.

Bathing. 1. M., 16. Says of course he likes to bathe in streams or he would not walk to the bay, two miles away, every day.

2. F., 15. Often walked a mile to take a bath in a stream.

3. F., 17. To be in water gives one a feeling of exhilaration.

4. F., 22. Used to enjoy bathing in fresh water. Generally feel the water on my skin with great pleasure.

5. F., 19. Before 13 did not care for the water. Then was taken rowing, and have liked it ever since.

6. M., 13. Am very happy when the boys say "let's go two-fingers."

7. F., 15. Like to paddle in water because the water has a feeling different from anything else.

8. F., 10. Love to paddle in shallow water when there are no snakes nor blood-suckers.

9. M., 12. Feels sorry for the children of the far North, who, though so near the water, cannot bathe in it.

10. F., 17. Enjoy bathing very much. Think it is because of the water upon the skin and the buoyancy.

11. M., 20. Used to like paddling in shallow water, but was afraid of deep water. Always shudder on going into deep, cold water.

12. F., 19. Always enjoyed plunge baths, though I shudder at the thought of going in streams because of the coldness of the water.

13. F., 22. As a child was so fond of bathing in streams that often went in three times a day.

14. F., 20. At the thought of going in used to shudder because I thought it so cold, but the first plunge over it was a pleasure for me.

15. F., 30. Enjoy a sea bath with a feeling of mixed pleasure and fear; do not like a plunge tub bath; can't quite raise my will to the point of putting my head under water, but when at the beach let the surf meet me more than half way. Much of the shudder is from the cold, but more, I believe, from dread of being submerged.

The last two rubrics give fairly representative expressions relating to being in the water. Although some do not enjoy bathing and swimming, yet the majority of the returns indicate a passionate love for it. Many of the dislikes noted corroborate the deductions made by Dr. Hall in his study of water fears. The thought of the coldness of the water on taking the first plunge or after getting out brings the "shivers" to many, and act as a deterrent factor. It is safe to assert that could all temperature conditions be regulated perfectly, few would hesitate about bathing. Long centuries of wearing clothing has sensitized the body to feel keenly the changes of temperature. Savages, peoples inhabiting warm climates, and boys accustomed to daily "swimming and sunning" through the summer forget all about the possibility of disagreeable sensations. Even with babes it is only the first shock that frightens, and then they love the water passionately, often crying to remain in. The first contact produces a shock upon the dermal sense organ, causing a gasp and often a tremor, but it is because of the newness and not the disagreeableness. Again, the fear of smothering from submergence as in 15 is frequent. Fear of snakes, blood-suckers, and other water animals (8), deep, dark water (11), motion of the water are frequently mentioned as deterrents, but the "feel" and buoyancy are always listed with the pleasureable and attractive features. It is a matter of every-day observation that most children are extremely eager to be in the water, to play and paddle about in it, or to play in tubs of water. After every summer rain they can scarcely resist getting out and splashing in the pools in which they caper and frisk about in high glee. If allowed to, during the rain they will run out hatless and shoeless and let the rain pelt down upon them. Many boys in the country have been known to get out of sight, strip off all their clothing, and take the keenest delight in staying out in the driving rain. The

beaches, river banks and brooks during the summer months could attest to boys' love for water. Under severest protest they will run away to go swimming, and undoubtedly more cases of school truancy in the summer are attributable to this attraction than any other. One gentleman of middle age says that nothing is so restful to him as to plunge into the water and float around, oftentimes upon his back, gazing into the soft blue sky.

This universal love for water seems not to be due to experience alone, for all babes exhibit it in their earliest days, if conditions are supplied. It seems partly instinctive and of more than recent philogenic origin, and at least suggests a survival of the old time life in an aquatic medium. This is not demonstrable, but the weight of all testimony is in that direction. How else can we account for the passionate love of children to paddle, to splash, ride on rafts, run out in the rain; for their intense delight in swimming, even going without meals, walking long distances, enduring severe punishments, etc., just for the sake of being in the water? Many of these characteristics are exhibited by adults when the conventionalities of civilized life can be thrown off.

Pedagogic Significance. The natural tendency of children to get near to nature, indicates that while children are passing through this animistic stage that they can be brought into sympathy with the great book of nature without appealing to artificial and esoteric interests. They already commune with nature and should be encouraged and aided in understanding and appreciating more of its beauties. At this stage it should not be minutely dissected and studied apart from its natural setting. The child idea of oneness and harmony should not be carelessly destroyed. Injudicious teaching may create ideas that the soundest philosophical teaching of maturer years will fail to correct. The unity of nature which the child mind and the savage instinctively apprehend should be strengthened, not weakened. Nature should not be dissected and sliced and teased apart until nothing related remains. By so proceeding all interest is destroyed and the most fundamental and important lessons to be taught are abortive. The child on looking at the ocean or river or streamlet, feels them to be sentient beings like himself only of a different form. Even older persons say they seem so, and some say they are happier in the instinctive feeling that water has a kinship of life with them than when conceiving it otherwise. The ocean's boundlessness produces feelings of nature's vastness and one's own insignificance. Awe, humility, and reverence, the basal ideas in religion, are prompted, as so many of the returns show, by gazing upon vast bodies of water.

The various forms of water are most eloquent teachers. They appeal to the child's imagination in a way that no human being could. So many say that they want to be alone by the water to contemplate, to reflect. Their thoughts are turned from the disunited artificial life, enforced by the usual modes of living, and turned toward the unity and harmony which they discover for themselves when brought into contact with nature. Contact with nature is a more genuine eloquent exhortation to a contemplation of the Divine than all the preachers without the aid of nature. When alone with the forests, the rocks, or the deep, for companions, one's thoughts turn instinctively toward the contemplation of the universal, which cannot but lead to a search for the primal cause, for the constant, the all powerful,—for God.

From a purely pedagogical point of view the study has much suggestiveness. The child that is impressed with the thought of "how large the world must be!" and with "wonder about what could be seen if the eye could penetrate space" has aroused in him the most fundamental conditions of the learner, viz., wonder and curiosity. A permanent interest of this general form is to be most earnestly sought in all instruction. To wonder what and why, and to determine to understand more, is the highest type of interest. It surpasses all the passing, definable, artificial interests. This is interest self-determined, and if cultivated will prove permanent.

Child life loves nature. These returns show that many of the happiest of childhood hours are spent directly in contact with it. To separate the child from nature is like separating the savage from his forest home. The child, like the race, may develop later interests in other directions, but the transition must be natural and gradual, and the feeling of oneness with nature should never be relinquished. From the wading and paddling and swimming in the brook, and from the sound of the merry music of brook and cascade to the more mature contemplation of the majestic ocean, there is a charm and a delight which are the rightful heritage of childhood and youth. To rob childhood of the beauties and teachings of nature is to do violence to the normal course of development. The childhood of the race was spent in delightful contact with nature; the child, ontogenetically recapitulating the phylogenetic development of the race, craves instinctively for communion with nature.

I am indebted to President G. Stanley Hall for the assignment of the problem, and for much sympathy and many helpful suggestions in carrying out the foregoing research. In this place I also desire to express my gratitude to the other members of Clark University who have aided me in many ways in prosecuting the work.

INDIVIDUAL MEMORIES.

By F. W. COLEGROVE, Honorary Fellow in Psychology,
Clark University.

This paper comprises one of nine chapters which treat of memory or memories. The preceding sections contain (a) An Historical Orientation; (b) A Biological Orientation which treats of racial memory and traces the individual psychical memory through different stages of life from man down to the vorticellæ; (c) The Diseases of the Memory—an original study based upon new material; (d) The Relations of Brain to Mind; (e) Memories. The subsequent chapters treat of Apperception and Association, Attention and Interest, and the final chapter is a summary of the leading pedagogical principles suggested throughout the work. The purpose of this paper is to give the results of a study of the memories of normal people from nine months to ninety years of age.

At the outset a real difficulty is met which is well illustrated in the following extract from "Recollections of Childhood," by Sonya Kovalévski. She writes: "When I begin to sort out and classify my earliest recollections, the same thing always happens with me: these recollections disperse before me. At times it seems to me that I have found the first definite impression which has left a distinct trace in my memory; but as soon as I concentrate my thought on it for a while, other impressions of a still more remote period begin to peep forth and acquire form. And the difficulty of it is that I cannot myself in the least determine which of these impressions I really remember; that is to say, I cannot decide which of them I really lived through and which of them I only heard about later on,—in my childhood—and imagine that I recall, when, in reality, I only remember the accounts of them. Worse still I can never succeed in evoking a single one of these original recollections in all its purity; I involuntarily add to it something foreign during the very process of recalling it." She then describes a scene in childhood, and adds: "As I reflect upon the matter now, I think I must have been two or three years old, and that the scene took place in Moscow where I was born." After the first memory she recalls "a series of detached but tolerably clear pictures" as of "picking up pebbles," and "my sister's doll which I threw out of the carriage window."

So many people have had the experience described by this "marvel of mental development" that the question may fairly be asked—can most people ascertain their earliest memories with sufficient accuracy and certainty to render them trustworthy data for scientific results? In order to test whether the difficulty would prove insuperable, one hundred persons were personally interviewed, most of whom were more than sixty-five years of age. The results of these interviews were such as to lead to the belief that after all deductions are made there is a large residuum which is reliable. Moreover the very difficulty alluded to is explained, at least in part, by the hypothesis advanced later in this study. The questionnaire read as follows:

1. What is your earliest memory? However trivial, or childish, your earliest experience is wanted. Be sure that it is a memory and that no one has told you.

In 1, 2, 3, give your age at the time, at least the probable age.

2. In like manner, give your second and third earliest memories.

3. What is your earliest recollection of your (a) father, (b) mother, (c) sister, (d) brother, (e) playmates, (f) of any injury from a fall or a blow?

4. Of what four consecutive years have you the best recollection?

5. Of what four consecutive years, after the first four have you the poorest memory?

6. Can you state examples of false memories experienced? *e. g.* Have you recalled as real what you had merely dreamed, heard or read? Give, if possible, a case of transposed memory in which what happened earlier was recalled later, and what happened later was recalled earlier.

7. What book read before you were nine years of age do you recall best?

8. Do you recall pleasant or unpleasant experiences better?

9. What studies have best developed your memory?

10. Give a condensed account of any case of loss of memory caused by a blow on the head, a fall or by disease.

11. Describe fully any aids to memory which you have found useful. How do you fix in mind and recall (a) figures, dates, dimensions, (b) forms of faces, microscopic structures, leaves, crystals, patterns, figures on the wall, carpet or dress, phrases in music and the cut of dresses? (c). How do you fix and recall passages of prose and poetry, declamations, and recitations? Why and how do you memorize fine passages? In learning foreign languages, describe devices for fixing new forms and phrases. Describe your system of keeping appointments. What memorandum do you keep, what book is used and how do you make entries? As a student, how full notes do you take in the class room? How would you teach a boy to remember things on time? Do you store up facts and dates, with no definite idea of how you will use them?

12. State cases in which the memory is so good or bad, that it weakens the other powers of the mind.

13. Describe cases of exceptional forgetfulness in old and young, stating whether it was due to distraction, abstraction, loss of mental power, or heredity.

As a rule, does defect in memory in children appear in the field of things done, known or felt?

14. As you advance in years do you find the interval between the power to determine whether you have had an experience and the ability to define, locate and name the experience wider or narrower? How is this in the kindergarten, high school, college, middle life, and old age?

The tabulation required almost incessant labor for five months. The results were first tabulated¹ upon two rolls of paper whose combined length was fifty-two feet by one foot eight inches in breadth. A second tabulation was made in which the memories (which could be readily studied from the first tabulation) were arranged under a large number of headings (over sixty), these headings being drawn from the papers themselves. Such topics were used as novel occurrences, repeated or protracted occurrences, gustatory memories, auditory memories, memories of father, mother, brothers, sisters, more distant relatives, other persons, deaths and funerals, sickness and accidents to self, sickness and accidents to others, memories of time, number, etc. Under novel occurrences or single impressions were included such memories as, seeing the ocean for the first time, drowning a cat, pet bird died, etc. By protracted or repeated experiences were included such memories as bringing water for mother in a little pail, the dress a person wore, etc.

To this topical syllabus 1,658 replies were received in time for tabulation. Of this number 1,372 were from white people; 605 males and 767 females. 182 were from negroes; 94 males and 88 females. 104 returns were furnished by Indians; 64 males and 40 females. The Indians represented 25 different tribes. The tabulations were made according to age in periods as follows: I, ages 1-4; II, ages 5-9; III, ages 10-11; IV, ages 12-13; V, ages 14-15; VI, ages 16-17; VII, ages 18-19; VIII, ages 20-29; IX, 30-39, etc. The last decade was practically 80-89, although a few males and one female 90 years of age sent returns, which were tabulated separately. The purpose in tabulating two year periods from 10-20 was to note the changes in memory, if any occurred, during this period of growth. The returns furnished many memories besides the first three. While the whole number of early memories did not differ essentially in character from the first three, the former furnish broader data for safe conclusions.

The youngest child whose memory was obtained was eleven months of age. She had apparently two definite memories. These experiences may not enter into the list of permanent memories. Yet a few adults state that they remember expe-

¹ I am indebted to my wife for the painstaking tabulations.

riences as early as one year of age,¹ and no definite limit can be set for the age of the earliest memories. The earliest memories of children under five years of age show the following range: The first number mentioned in each group of two representing males, and the second number females.

Novel occurrences or single impressions: fifteen, thirty-one; Protracted or repeated occurrences: sixteen, nine; Visual memories: twelve, sixteen; Auditory: four, two; Emotional: one, one; Gustatory: —, three; Motor: eight, nine; Tactile: one, two; Father: two, three; Mother: five, one; Grandparents: one, —; Brothers and sisters: two, one; Playmates: four, one; Other persons: three, two; Temperature: one, —; Topographical: seven, two; Logical: six, —; Clothing: five, one; School: —, two; Home: —, one; Visitors: —, two; Visiting: —, one; Running away: —, one; Corporal punishment: —, one; Dolls: one, nine; Sickness and accidents to self: five, three; Sickness and accidents to others: one, —; Deaths and funerals: one, —; Domestic fowls and animals: two, three; Fright: one, one; Colors: three, five; Playthings: four, four; Gifts: two, seven; Christmas: one, six; Playing: one, two; Activity of others: one, three; Attendant circumstances: one, —; Intellectual: one, —; Physical pain: one, —; Number: —, one; Trees: —, two; Mechanical: one, —; Teasing others: one, —; Time: one, —; Where slept: one, —.

It will be seen that the males have the greatest number of memories for protracted or repeated occurrences, for people and clothing. They excel also in topographical and logical memories. The females have the better memory for novel occurrences and single impressions, for Christmas, gifts, and, as would be expected, for dolls.

In the 5-9 period, the males again excel in the memory for protracted and repeated occurrences, the females for novel occurrences or single impressions. The motor memories here have a marked increase in the case of the females, and a slight increase for the males. The memory for all persons shows a noticeable increase with the females. For the males the personal memory improves for near relatives only. In the case of each there is a better memory for the activity of others.

In the next period—age 10 and 11—motor memories decrease for the females and increase for the males. Memories of near relatives increase in the case of both, while memories for other persons decrease. Memories of sickness and accidents to self and of playing are emphasized.

In the 12-13 period the percentage of memories for novel oc-

¹ This accords with the researches of V. and C. Henri. See popular Science Monthly for May.

currences decreases in the case of the females, while those for protracted experiences increase. Both males and females show a decrease in memories for near relatives, and an increase in those for playmates and other persons. Sickness and accidents to self are remembered less by males and better by females than in the preceding period. Memory for the activity of others increases in the case of the males and decreases in the case of the females.

In the period which includes those fourteen and fifteen years of age it is worthy of note that the motor memories nearly culminate for the males, but decrease in the case of the females. These memories seem to harmonize with the psychical and physical life of the period. Mischievousness and destructiveness are well remembered. The males have a decrease in the proportion of memories of novel occurrences and an increase in those for repeated occurrences. The reverse is true in the case of females. The males show a marked decrease in memories for relatives and playmates and an increase in those for other persons. Topographical memories increase in the case of each, as do visual and auditory memories.

In the period 16-17 the relations are again reversed so far as novel occurrences and protracted experiences are concerned, the females showing an increase in memories for the latter and a decrease for the former. In the case of the males the opposite is true, and the percentages become essentially the same as in the period 12-13. The females show a slight increase in memory for all near relatives and playmates, and a greater increase in memory for other persons. The males show an increase in memories for playmates and relatives, and a decrease in memories for other persons. The females have a marked increase in the memory for fears, the males for the activity of others.

In the period 18-19 there is an increase in the visual memories for each sex, and the auditory memory of the females improves. The memory for the activity of others shows an increase in the case of each, and it is strongly emphasized for the males. The females excel in the proportion of memories for protracted or repeated occurrences, and the males in that for novel occurrences and single impressions.

Dr. G. Stanley Hall and Drs. Lancaster, Starbuck and others, have found that puberty exerts a great influence upon the entire psychical life. In order to test its effect upon memory the exact pubertal age was obtained by Miss Williams of 110 females who had answered my questionnaire. Of the 110 cases, in 37 puberty occurs in the period of best memory; in 9 it occurs in the period of poorest memory; in 50 it occurs between the periods of best and poorest memory; in 14 it occurs

after the periods of both best and poorest memory. In 16 cases it occurs at the beginning of the best remembered period. In 4 cases it occurs at the close of the best remembered period. In 5 cases it marks the division between the best and poorest memory. In two others it occurs at the close of the period of poorest memory.

The returns give evidence that the period of adolescence is one of great psychical awakening. A wide range of memories are found at this time. From the fourteenth year with girls and the fifteenth with boys, the auditory memories are strongly developed. At the dawn of adolescence the motor memory of boys nearly culminates, and they have fewer memories of sickness and accidents to self. During this time the memory of others persons and the activity of others is emphasized in case of both boys and girls. In general at this period the special sensory memories are numerous, and it is the golden age for motor memories. Now, too, the memories of high ideals, self sacrifice and self forgetfulness are cherished. Wider interests than self and immediate friends become the objects of reflection and recollection.

The decade 20-29 is perhaps to most people as important a decade as any. At this period there is a marked change in the memory content. For the second time the proportion of memories for novel occurrences and for protracted or repeated experiences is nearly the same in the case of males and females. The males show a noticeable increase, and the females a marked decrease in visual memories. The same is true of the auditory memories. The memory for grandparents nearly culminates in the case of the females, and increases in the case of the males. The females show an increase in logical memories, and a more decided increase in topographical memories than do the males. Memories of sickness and accidents to self decrease with the males and increase with the females, while in the case of both there is relative decline in the memories of sickness and accidents to others.

In the decade 30-39 memories involving reflection and thought seemingly ripen. The logical, intellectual, topographical and visual memories for the males culminate here, also those for time, number, colors and father. The visual and auditory memories of the females culminate, while the intellectual, logical and topographical nearly reach the zenith. Memories for joy, quarrels, pride, jealousy, Christmas, physical pain and weariness disappear. The predominant memories are of a thoughtful cast. This is a conservative period, as no new memories are introduced.

In the decade 40-49 memories for persons tend to fall away. One is almost surprised to find the motor memories of the

females ascend and reach their maximum. Their tactile memories also advance and culminate in the next period.

In the decade 50-59 the motor memories of the males culminate and again appear strong from 80 to 89. We have seen that they nearly reach their maximum at 14, and in all subsequent periods they are well represented. According to Ribot the motor elements are primary in all emotions, and they seem to be among the most abiding of memories. The memory of the males for physical pain and weariness culminates from 60 to 69; that of both males and females for school culminates from 70 to 79; and that of the males for wearing dresses from 80 to 90. The boy's first trousers are remembered best in the first and last periods of his life. In the last decade the chief classifications are still represented, but it is noticeable that the auditory and tactile memories entirely disappear in this period. Memories are no longer found for grandparents, sickness and accidents to self, gifts and Christmas. On the other hand visual memories and those for near relatives are well represented.

As already stated in the replies to the questions calling for the first three memories, a much larger number than three was frequently given. Moreover other questions called for earliest memories of relatives, playmates, etc., so that a much larger number of memories was obtained than the first three of each individual. White persons reported, as the second tabulation shows, 6,222 memories, 78 per cent. of which were novel occurrences or single impressions, and 22 per cent. protracted or repeated experiences. The males had $76\frac{2}{3}$ per cent. memories for novel occurrences, and $23\frac{1}{3}$ per cent. for repeated impressions. With them the memory for novel occurrences culminates in period VII, ages 18 and 19, when they constitute $83\frac{3}{8}$ per cent. of all memories. With females the memory for novel occurrences culminates in period III, ages 10 and 11, when they constitute 89 per cent. of all memories. They drop to $58\frac{3}{8}$ per cent. with the males during the two periods 70-79 and 80-89, but rise at 90 to $84\frac{3}{8}$ per cent. With the females they also drop to $58\frac{7}{10}$ per cent. in the period 80-89.

The memories of repeated occurrences in the case of the males culminate in the first period (ages 1-4), when they constitute $51\frac{3}{8}$ per cent. of the memories. They become $35\frac{3}{8}$ per cent. in period X, ages 40-49. With the females they are $22\frac{1}{2}$ per cent. in the first period, ages 1-4, and do not form a greater proportion except during three periods: VII, ages 18 and 19, when they are $27\frac{3}{8}$ per cent., XI, ages 50-59, and XIV, ages 80-90, when they become $31\frac{2}{10}$ and $41\frac{8}{10}$ per cent., respectively, of the whole.

The fact that different memories culminate at different periods

may be significant. In not a few instances they seem to bear a relation to the whole mental life of the period. In order to determine this relation more definitely we shall now consider the periods when the memories more frequently found become a chief factor and reach their highest percentage. The visual memories are $27\frac{1}{3}$ per cent. of the whole for the males, and 31 per cent. for the females. In the case of each they are a large factor in the first period, 1-4, when the child is exploring the world. With both males and females they culminate in the fourth decade, 30-39. In this period observation is ripest. In the case of the males the percentage is low in the 8th and 9th decades—70-89, and improves in the tenth, as if second sight were obtained. The auditory memories become accentuated with the males in period VI, years 16 and 17, and culminate in years 20-29. With the females they become emphasized in period V, years 14 and 15, and culminate in years 30-39. The periods of culmination are epochs when the auditory sense is much used as a rule. Men and women are busy, "hear what is going on," and do not spend much time in reading. It is worthy of note that in the period 80-89 for females and the 90 period for males, an age when the hearing is poor, there are no auditory memories. The motor memories come in great profusion at 14 and 15 for the males. At this period the motor memory is intensely motor, of a break bone and accident nature. On the other hand with the females at this period there is an actual falling off of 4 per cent. in motor memories. The motor memories, however, in case of the males, culminate in years 50-59 by a margin of $3\frac{1}{2}$ per cent. over the 14 and 15 period, and with the females reach their maximum at 40-49. This may not easily be explained, but it is a period of life when activities have fallen away little, if any, and achievement and the results of activity are the objects of reflection.

The memories of brothers, sisters and playmates, culminate in the seventh period for females, and in the eighth for males, and then steadily diminish until second childhood begins. The memory of females for the mother exceeds that of the males by $4\frac{1}{4}$ per cent., while males have a better memory for the father than females. The memories of the males for their grandparents reach the highest points at (a) 5-9, (b) 30-39, (c) 60-69; those of the females at (a) 5-9, (b) 20-29, and (c) 50-59, the years (a) when they have most to do with their grandparents in their own home, (b) when their children are small and their own parents first become grandparents, (c) when they become grandparents themselves. The natural interval of ten years between the ages of males and females in the last two cases may be noted. Memories for deaths and funerals are recalled by the females almost equally well in the years from 60

to 90, and are not strongly marked before this time. Those of the males culminate at 90, but are very marked from 70 to 79. Is it not true that the memories of any period are in harmony with the general psychological life of that period, and do they not to a certain extent partake of its qualities? These facts suggest that what is remembered does not primarily constitute definite memories, but a memory complex. From this complex, at subsequent periods of life, those parts are selected out and made distinct which are en rapport with what may be termed the memory tone of the period; *e. g.*, if the period be one in which the auditory sense is much used, or be one of great logical activity, auditory or logical memories will be prominent. This hypothesis explains the cases of individuals in whom certain types of memory are pronounced. It also explains those cases in which persons assert that they cannot single out early memories. "It is all one mass," they say. Such minds are little given to reflection upon the distant past. They have not tried to separate the single elements of the complex. When they consent to reflect for a time, they are usually able to differentiate single elements and to arrange them in serial order. Yet what these elements are will differ with the age of the individual or with his memory tone. The memories for sickness and accidents to self culminate for the females in years 12 and 13, and for the males in years 14 and 15. Sickness and accidents of others are best recalled by the females in years 14 and 15; by the males in period 12 to 13. Females have the better memory for sickness and accidents to others. Males have the better memory for sickness and accidents to self. The activities of others are best recalled by both males and females in the closing periods of their lives.

In the general average for the whole life it is interesting to note that the females have a slightly higher percentage of visual, auditory, gustatory and tactile memories than the males. The gustatory memory is $3\frac{7}{10}$ per cent. for the females, and culminates in the first period, while among the males it is $2\frac{3}{4}$ per cent., and culminates in period 5-9. Memories for odors are very few, being $\frac{1}{4}$ of one per cent. for the males, and $\frac{1}{8}$ of one per cent. for the females. The males have two per cent. more logical memories. The females have from $2\frac{1}{2}$ to 4 per cent. better memory for mother, playmates and other persons. They have $7\frac{1}{2}$ per cent. better recollection of brothers and sisters, and 7 per cent. less of topographical memories than the males. Motor memories, father, grandparents, gifts, playthings and fears, are about equally recalled by each, but the females have double the memories for playing. The female memory for dolls is $3\frac{2}{3}$ per cent., and culminates in the first period, years 1-4, when it is $22\frac{1}{2}$ per cent. of all memories.

The male memory for clothing is 6 per cent., the females $7\frac{1}{2}$ per cent. The males have 7 per cent. of school memories, the females $5\frac{1}{2}$ per cent. The memories of the males for home are $1\frac{1}{2}$ per cent., of the females $\frac{1}{10}$ of one per cent. The males have nearly 8 per cent. of memories for domestic animals and fowls, which culminate in period 40-49; the females have only $2\frac{1}{4}$ per cent. of such memories, which culminate in period 50-59. Time has $2\frac{8}{10}$ of memories with each. Number memories are $1\frac{1}{4}$ per cent. for the males, and a little less than one per cent. for the females. Memories of colors are $4\frac{1}{4}$ per cent. for the females, $3\frac{1}{3}$ per cent. for the males. The males have $2\frac{2}{3}$ per cent. of memories of deaths and funerals; the females $1\frac{1}{2}$ per cent. Memories of trees are $1\frac{1}{4}$ per cent. with the females, and $\frac{1}{2}$ of one per cent. with the males. The following memories should also be mentioned: Picture taken; pride; visit to dentist; quarrels; storms; money; jealousy; shame; lie; selfishness; curiosity; birthdays; being lost; deceit; stealing; picnics; circus; parades and soldiers; praise; temperature; visiting; $4\frac{1}{4}$ per cent. for females, $2\frac{1}{4}$, males; visitors $2\frac{1}{4}$ per cent. for females, $1\frac{1}{4}$, males; reproof, which is remembered $\frac{1}{3}$ as well as corporal punishment; running away; mud pies; crying and grief; anger; attendant circumstances; fishing; swinging; hair; sliding; physical pain; fatigue; malice; losing things; being praised; enemy; birthday; laughed at; playing horse; imitation; where slept; destructiveness; being kissed; disobedience; church; wedding; surprise; jealousy; teasing; mischief; guilt; blood; charity; revenge; working; supernatural; love; sorrow. The last eight memories are found for the first time at senescence.

The average age for the three earliest memories at different periods under the age of 25 is shown by the curves here given. The continuation of the same curves during the remaining periods is described in Figs. 1 and 2. The three lower lines represent the early memory of the males, and the upper ones of the females. The heavy line represents the first memory; the broken line the second, and the dotted line the third memories. Distance to the right represents the age of the person reporting; distance upward indicates the age of the person at the time of the occurrence remembered. For the first memory during the entire period, it is less than three years. The first rise in the curve is naturally marked because it begins low at the age of one. It drops at $4\frac{1}{2}$ and five for the first two memories, which may be due to some acquired ability to reflect upon the past. Children under this age have not been given to reflection, and it is very difficult to get them to bring forth the memories which later years will prove that they already possess. There is a rise in all of the curves at adolescence which is emphatic in the case of four of them. This shows that from the age of 13 to 15,

Fig. I.

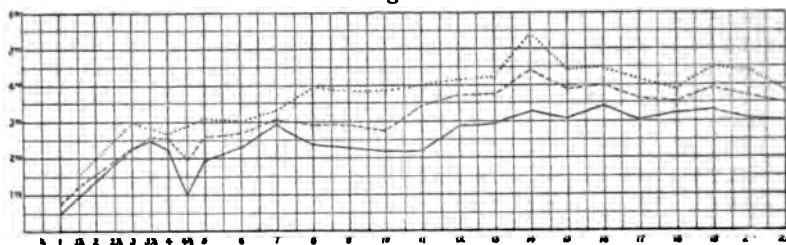
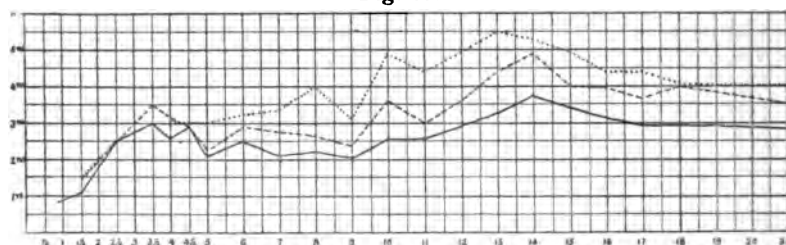


Fig. II.



boys and girls do not recall so early memories as others do before and after this period. At this period the present is large and the future makes a strong appeal. While the storehouse of memory is very rich now, perhaps the temperament or the psychical tone is now wanting in accordance with which painstaking reflection calls forth the earliest experiences. At any rate the earliest memories of boys at the age of 14 average almost four years, and for the girls it is more than three. At 35 the curve for the males descends and approaches two years, which is the average age for the first memory of boys at nine and five years of age. The curve for the earliest age of the females descends slightly at 30 and 40, and then fluctuates, rising slightly at 80 to descend again. The curve for the males rises at 70 and descends gradually, later terminating in the height reached at 6, 10 and 11.

The curves for the second and third memories call for no discussion as the representation is apparent. They show, however, a tendency to sympathize with the first. One fact seems clear from this study: There is not a progressive fading-out of memories as life advances and declines. The range of subjects recalled may narrow a little toward the close, but if a corresponding amount of data could be gathered, even this might be doubtful. The garrulous mode of talking prevalent among old people seems to be due to complete associations in which few petty details are omitted. Moreover the memory of the aged goes back practically as far as does that of young people, and is as clear and vivid. On the farm at my early home is a trout stream whose waters are clear and cold. In

childhood I saw the tree-tops and mosses mirrored in the clear waters. The stream has narrowed down a little owing to the cutting away of the forest. The branches now reflected there have changed somewhat, not by time, but by elements at work in time. If in old age I see them, the branches may be the same, but changed a little more. Such is the memory stream, narrowed a little, it may be, in the passing years, but the waters flowing as clear as ever from the same springs, mirror the old experiences.

Comparing the Indian males with the white males of the same period, the Indians show a higher percentage of memories for hearing, taste, mother and playmates, crying and grief, corporal punishment, trees, quarrels, and almost double for domestic fowls and animals. They have a higher percentage of tactile memories, and a smaller per cent. for dress and persons not relatives. The following memories are wholly or chiefly Indian: Fishing, snakes, squirrels, negroes, hunting (bow and arrows), lakes and streams, and tobacco.

Comparing Indian females with white females of the same age, the Indians have a larger percentage of auditory, gustatory and motor memories, also for father, mother, playmates, fear and dolls; much greater for crying and grief, and double the percentage for domestic fowls and animals. They have a smaller percentage of memories for persons not related, dresses and other clothing, fewer topographical and logical memories, and less for sickness and accidents to self and others, and for the activity of others. The following memories belong wholly or chiefly to the Indians: Lakes, rivers, wolves, coons, owls, fishing, skating and negroes.

The Indians who sent returns represent 25 different tribes, and may be considered fairly representative. Some of the tribes are in a low state of civilization, but many came from families of wealth and culture. Many of these memories may be termed crystallized racial experiences, and the question arises whether the memory tone is not modified by atavistic tendencies. As will be seen later, their memories for pleasant and unpleasant occurrences savor of racial experiences. The curves for the first three memories of both males and females average higher than those of the whites. That for the earliest memory of the males fluctuates between three and four until the age of 21 is reached. At this point it drops below 3, rises from 21 to 22, drops again, and with the curve for the second memory reaches its lowest point at 26. The third memory for this period is high. The curve for the earliest memory of the females reaches its lowest point by a rapid descent at 25. The second and third memories average 4 and 5, respectively, and are liable to reach the age of nine.

The curves for age, of the negroes, at the time of the first three memories show a higher average than those for the whites. The earliest memory of the males is usually found between three and four. The curve representing it is lower than 3 at the ages of 14 and 15; it also descends to three at the ages of 23, 24 and 27. It is high from 16 to 18, and culminates at 22. The second earliest memory ranges from 4 to 6, but at the age of 14 drops below 4. The curve for the third earliest memory fluctuates from $4\frac{1}{2}$ to 9. The curve representing the earliest memory of the negro females descends to 2 at the age of 25, and at this period the second earliest memory descends to 3. The curve for the first is higher at the age of 26, when it is $4+$. The curve for the third memory is noticeably high during the period from 14 to 16. The first and second are high from 15 to 17. The curve for the third memory is high again from 19 to 25, when it descends. The curve for the second memory, like that for the first, falls at 22, and both reach a very low point at 25.

The negroes do not seem to differentiate the memories from the memory complex until late in life. This may be due to the poverty of the mental experience in early life. The memory tone is monotonous. Further evidence of this is a strong tendency to remember by comparison. Such an event occurred in "Garfield's or in Harrison's administration," or "after I went to school." But the best educated negroes, as would be expected, have sharply defined and well differentiated early experiences. Their memories, too, have less of the grotesque character. The story of hardships, wrong and suffering is deeply imprinted on many memories.

It was to be expected that the negro females would place emphasis upon dress. The racial experience also crops out. One could hardly find an Indian or white child afraid of a candy sheep's head because the teeth showed, but this was the earliest memory of a negress.

The replies to questions 4 and 5 were tabulated together with replies to questions asked persons past fifty years of age regarding the decades best and poorest remembered. The years best remembered by males of all ages are the 16th and 17th, which are equally well recalled. The 15th year comes next, followed by the 19th and 14th in the order given. The poorest remembered year is the 8th, and the second poorest the 7th. From 46 to 50 there comes a tendency to remember the last 4 years or the last decade most poorly, and the red lines representing the best remembered years, and the black lines representing the poorest remembered years mingle together. After this period, as a rule, the last 4 years, or the last decade is least remembered. There are notable exceptions, however.

A few represent the whole life, after the first 4 years, as best recalled, and know no poorest memory. The statement is made by persons past 80 that they still recall passing events well, in which they become interested, and to which they give attention. Middle aged people frequently designate the years 20-25 or 25-30 as the best remembered, for the reason that important changes were then occurring.

The poorest remembered year for the females also is the 8th, and the next poorest recalled is the 7th. Their best remembered year is the 15th. At the age of 50 the lines representing the best and poorest recalled years mingle freely, and after this the tendency is to recall the last 4 years or the last decade with the greatest difficulty. Here, too, are notable exceptions. It is worthy of note that the years poorest recalled by all persons are the 8th and 7th respectively. For all persons the years best recalled are those characterized by the great psychological and mental awakenings of adolescent life. It is true that after 50, proper names, at least, are not so well recalled. An explanation given by the returns is that middle aged people have many more acquaintances and fewer intimate friends. The early memories abate little to the last. At every period attention and interest are the handmaids of memory.

The sixth question called for false memories. The returns fully justify the discussion in a previous chapter as to the influence of dreams. There are inverted memories, and defective localization in the past is fairly common. The period 16-19 is that in which false memories are most common. The experience at this age is fairly common to both sexes, but the males are able to give fewer definite examples. Yet, while false memories are more common at this period, no time of life seems free from them.

Y. F., f., age 16. Read of robbery in paper, and told it as seen.

A. N., f., age 16. Told playmate a dream, and was punished for lying.

A. B., f., age 17. Four years ago I dreamed a person was dead, and supposed it was true until I met her a year ago.

M. C., f., age 17. Dreamed of a fire, and the next day asked if a friend went to it.

L. C., f., age 17. Dreamed that price of potatoes had gone up, that mother had told me so. Found out my mistake at the dinner table.

F. C., f., age 17. Dreamed mother had bought me a new dress. Looked for it all over the house.

M. D., f., age 19. Told teacher of a visit to Washington. Had never been there.

H. D., f., age 17. Dreamed uncle had come to visit us. Next morning asked mamma if uncle had come down to breakfast yet.

T., f., age 9. Mistook event near close of voyage home from Scotland to have been on the outward voyage.

M., f., age 17. Visited a friend five summers ago. The friend visited her seven summers ago. M. states that she made the first visit, and no amount of explanations and dates changes her mind.

T., m., age 19. Member of foot-ball team, in writing from memory a report of the games in which he played, often related events as occurring at the beginning of the game which, as a matter of fact, occurred later. This was brought to his notice by men who stood on the side lines and kept running notes of the game.

F. W., m., age 26. College graduate. Thought aunt told me something coming home from a funeral 8 or 10 years ago. Recently learned that she and I returned from the funeral in different carriages, and that it was told me by another relative.

A. F., m., age 18. Often thought I was at a feast in the woods before I was born.

R. C., m., age 15. Have an impression of having done something ages before.

C. B., m., age 17. Dreamed there was a train of cars in the closet for me, but found none.

E. L., m., age 14½. Dreamed I had a bushel of pennies, but could not find them.

A. H., m., age 19. Dreamed of landscapes which I never saw. They seemed real.

Some of the dreams may remain permanently as real, but they are apt to be corrected by experience.

Question seven called for the book read before the age of 9 which is best recalled. Books which appeal strongly to the imagination constitute a large portion of those mentioned. The influence of rhyme also apparently aids the memory. The books most frequently mentioned, 180 in all, fall under the heading of light stories and nursery rhymes. While short children's stories are included, the Mother Goose Melodies, Jack and the Beanstalk, etc., make up a large part of this heading. The younger people, especially, recall the pictured story books which they have seen in rich profusion. Here might have been placed Little Lord Fauntleroy, mentioned by 14, and Babes in the Woods, by 3.

The second division comprises novels which lead school books by the slight margin of 92 to 90. The list of novels is largely increased, however, by books mentioned separately, and which were not included in the above estimate. Such are Pilgrim's Progress remembered by 20, Black Beauty by 17, Uncle Tom's Cabin 14, Oliver Twist 3, Beautiful Joe 1, Tom Brown's School Days 1, Rip Van Winkle 3.

Fairy Tales by Grimm, Andersen and others, come next, 82, not including Cinderella 25, Arabian Nights 5, Æsop's Fables 2, Blue Beard 8.

Returning to novels one separated from the general list is designated almost as many times as are all other novels. It is Robinson Crusoe mentioned 71 times. The Swiss Family Robinson is mentioned 25 times, Gulliver's Travels twice. Of other books Bible stories are designated by 43, didactic works by 11, biography by 14, history by 13, natural history by 16. Little Men by Miss Alcott is mentioned by 9, and Little Women by

16. A middle aged man writes that he recalls *Little Men* better than any book he has ever read. Essays are mentioned by 3, *Moody and Sankey Hymn Book* by 1. *The Scrap Book* and *Brownies* have one vote each. *Peck's Bad Boy* is mentioned twice.

The pedagogical significance is unmistakable. What appeals to the child's imagination interests him, and as a result remains in memory. Historical and didactic novels are most potent of the permanent influences. Scott and Lord Lytton, not mentioned here, if read early will be remembered. The Bible stories are the portions of sacred Scripture best suited to the child. Biography is well remembered and most instructive. There could be no better reading to appeal to the permanent interest of the young, than some of the best of Jowett's *Dialogues of Plato*.

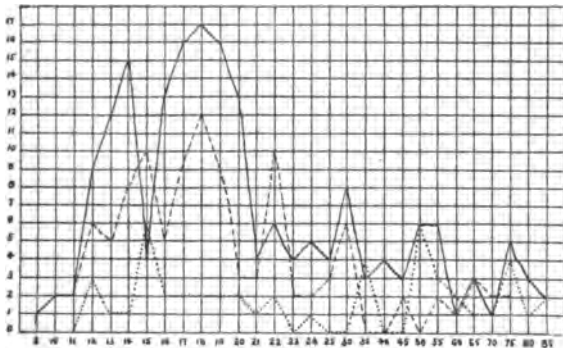
PLEASANT AND UNPLEASANT MEMORIES.

"The thought of our past lives in me doth breed perpetual benediction."

A large number of replies were received to the inquiry, "do you remember pleasant or unpleasant experiences better?" The replies are illustrated by the curves here given.

The figures at the bottom give the age of the persons interviewed; the height of the curves gives the relative number of replies; the heavy lines representing those who remember the pleasant better, the broken lines those who remember the unpleasant better, and the dotted lines the number who could make no choice. It is the relative rise of the curves representing the pleasant and unpleasant memories, and not the absolute rise of one at any point or points that is significant.

Fig. III.



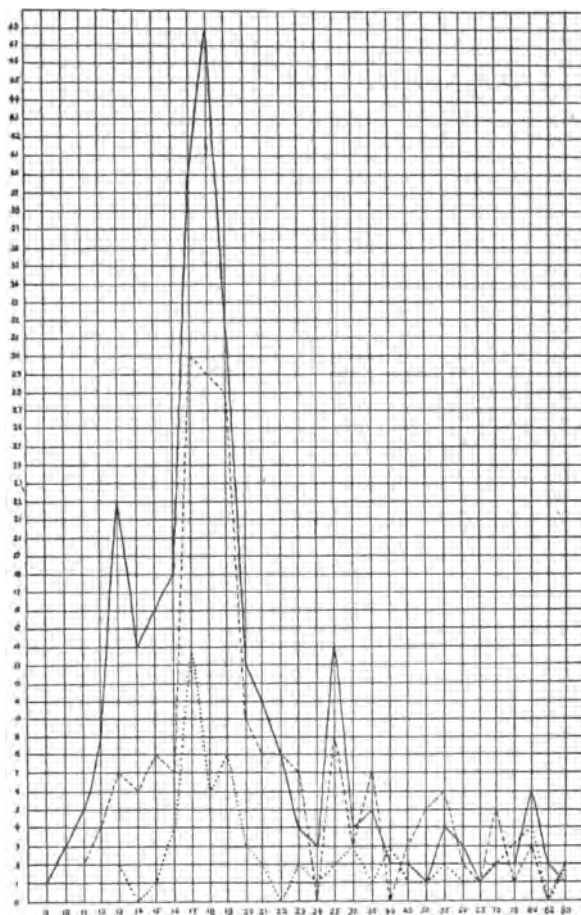
Curves representing the pleasant and unpleasant memories of white males.

As will be seen the pleasant and unpleasant memories of the male whites rise and fall together until the age of 21. At 22,

in the case of the males, the curve for unpleasant memories is the higher, after which the pleasant memories are in the ascendancy. After the age of 30, unpleasant memories are little recalled by the males.

The unpleasant memories have a larger share in the woman's mental life than in that of the man.

Fig. IV.



Curves representing the pleasant and unpleasant memories of white females.

The unpleasant memories play the important rôle in the case of the Indian and Negro males. One can hardly fail to see in it a suggestion of persecution and slavery. The Indian females show a slight tendency toward remembering unpleasant expe-

riences best, and share the sorrowful experiences of their

Fig. V.

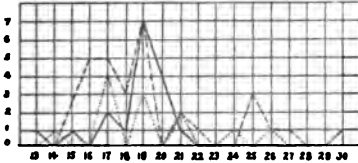
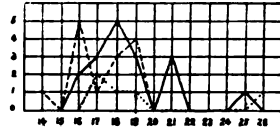


Fig. VI.



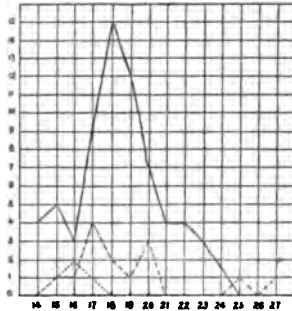
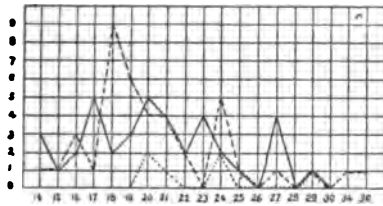
Curves representing the pleasant and unpleasant memories of Indian males,

Curves representing the pleasant and unpleasant memories of Indian females.

brothers. On the other hand, in the case of the negro females, unpleasant experiences play a very minor part indeed. With them a dress of striking color appears easily to efface grief.

Fig. VIII.

Fig. VII.



Curves representing the pleasant and unpleasant memories of Negro males.

Curves representing the pleasant and unpleasant memories of Negro females.

For many years the warning against memoriter work has been so persistent that one almost feels like apologizing for asking the question—"what studies have best developed your memory?" The thesis that memory ought not to be trained has been supplemented by the other that it cannot be trained. These ideas have made for advancement. They have also wrought injury. Have college students the ability to-day that they had fifteen years ago, to reproduce an author's thought and to think while upon their feet? The question in the topical syllabus called forth a great number of replies. Almost all of the studies in the curricula of High Schools, Normal Schools and Colleges are mentioned. We must allow for the fact that studies most commonly pursued will be mentioned most frequently. History easily takes the precedence, being mentioned 229 times. Some specify learning the dates, but with the great majority the work of fixing the salient points at different epochs, and wide collateral reading, are believed to have aided the memory. It is but natural that a close ally, geography, should come next. It is mentioned 147 times. Arithmetic comes next, having 124 votes. Many specify the committing

of the rules and tables. The tables for denominate numbers form an admirable memory drill. Geometry is mentioned 66 times, and algebra 27 times, while mathematics is mentioned 55 times. In certain schools where mathematics are well taught they have a large percentage of votes. Latin is mentioned 67 times, some add "when taught in the old way." No other language is to be compared with the Latin in the number of its adherents, although Greek is mentioned 8 times, (many more have studied Latin than Greek). French 7 times, German twice, and Language by 19. If this be true of foreign languages we are not surprised to find that English Literature has 74 votes, English grammar 47, poetry 45, general reading 36, recitations and declamations 30. Many state that their memory has been improved by memorizing gems of literature. Spelling is mentioned 27 times, science (general science) is mentioned; chemistry and physics are each named 5 times, physiology 14 times, botany twice, and zoölogy three times. Music is mentioned 8 times. Other studies named are Moral Philosophy 1, Psychology 11, Drawing 1, Catechism 3, Bible verses 9, Pedagogy 1, Political Economy and Civil Government 1 each. The Indians mention short-hand and phonography as helpful in training the memory. They also give other studies mentioned by the whites. The negroes, with two exceptions, refer to text-books and other books mentioned by the whites. It is probably true, as stated in another chapter, that nature assigns memory limits to each individual. There is as little doubt that within the limits assigned by nature the memory is susceptible to training, and is developed more by some studies than by others.

The request contained under heading 10 of the syllabus—"give a condensed account of any case of loss of memory caused by a blow on the head, a fall, or by disease," elicited a number of suggestive replies. These results are not significant as compared with the carefully collated results in chapter 3, studied under medical supervision. They show, however, that loss of memory due to traumatism and disease are fairly common and carefully observed by the folk consciousness. Instances given are as follows:

I. J., m. Head injured during foot-ball game. Could not remember signals.

Grandmother in usual health lost all memory for $1\frac{1}{2}$ days.

M., f. Suffered nervous prostration, had to learn A. B. C.'s over. She afterward became a High School teacher, but was forgetful.

E. G., f., age 19. Crossing the ocean forgot all had learned. It came back at age of 15.

M., f., age $7\frac{1}{2}$. Broke arm. Next day asked why it was tied up. Had forgotten the name of the pussy cat, etc.

B., age 8. Scarlet fever, forgot everything, and had to learn over.

A number of instances were given in which the secondary automatic movements of children were lost by disease.

E., m., age 2. After a fever he had to learn to walk over again.

Man fell. He did not know his own name for 2 years. After the death of his wife it all came back to him.

Man fairly educated, after typhoid fever had to learn to spell.

M. W. Fell down stairs three years ago. Cannot remember names since, nor can he identify persons.

F. Can recall nothing which transpired before an illness at 6.

Child fell from barn. Forgot being on the barn.

Quinine affects the memory of one.

L. L., f., age 15. Crossed Pacific Ocean at 4, sick, forgot Chinese language. It came back upon return to China 2 years later.

That the memory is affected by the state of the physical health is a widespread, popular belief, due to experience. A "close, stuffy room," and "lack of mental power due to fatigue," are mentioned as prejudicial to a good memory.

E. M., f., age 18. Broke limb at 9, took chloroform. Memory for years 1-9 poorer since. She attributes it to the chloroform. Others believe that chloroform has affected their memory.

H. K., Indian, age 24. "I was playing foot-ball, and once while running with the ball I was tackled by an opponent, who threw me on the flat of my back, with his own weight on top of me, my head striking the ground at the same time or a little before my body did. I got up in a little while, said I was not hurt for I felt no pain, so they began playing. They called the signals and I stood still. I could not place the meaning of the numbers. I did not even know my own number, so after the play was made I stepped to the other 'half-back' and asked him what my number was. Before the fall I knew the signals as well as any man on the team. Of course I had to retire from the field. I could not remember from one minute to the next. I knew what I was doing, and knew at the time that I could not remember a thing. There were three days that I could not remember anything. It just seemed that a door would shut on everything I did, and in less than a minute I would be doing the same thing over again."

A well known pedagogical principle is that vivid impressions are easily recalled. With frequency, recency, and emotional congruity, vividness plays an important rôle in association. In order to test the abiding character of a vivid experience 179 middle aged and aged people were asked in personal interviews the following question: "Do you recall where you were when you heard that Lincoln was shot?" An affirmative answer required the exact location, an example of which is the following reply: "My father and I were on the road to A—in the State of Maine to purchase the 'fixings' needed for my graduation. When we were driving down a steep hill into the city we felt that something was wrong. Everybody looked so sad, and there was such terrible excitement that my father stopped his horse, and leaning from the carriage called: 'What is it, my friends? What has happened?' 'Haven't you heard?' was the reply—'Lincoln has been assassinated.' The lines fell from my father's limp hands, and with tears streaming from his eyes he

sat as one bereft of motion. We were far from home, and much must be done, so he rallied after a time, and we finished our work as well as our heavy hearts would allow."

Not all the replies were so vivid as this one, but only those were accounted as affirmative which contained facts as to time of day, exact location, and who told them.

J. P., age 76. I was standing by the stove getting dinner, my husband came in and told me.

M. B., age 79. I was setting out a rose bush by the door. My husband came in the yard and told me. It was about 11 o'clock A. M.

H. R., age 73. We were eating dinner. No one ate much after we heard of it.

J. T., age 73. I was fixing fence, can go within a rod of the place where I stood. Mr. W. came along and told me. It was 9 or 10 o'clock in the morning.

L. B., age 84. It was in the forenoon; we were at work on the road by K.'s mills; a man driving past told us.

Of the 179 persons interviewed, 127 replied in the affirmative, and were able to give full particulars; 52 replied in the negative. A few who gave a negative reply recalled where they were when they heard of Garfield's death. Inasmuch as 33 years have elapsed since Lincoln's death the number who made an affirmative reply must be considered large, and bears testimony to the abiding character of vivid experiences.

Many helpful pedagogical suggestions were received from High School, Normal and College students in reply to question 11. Figures are mentally represented as clearly as possible,—a "picture of them as they look printed or written." A child thought of the figures to be carried in division as "gone up in the attic." He would "call up attic to see if anything was there." One "locates them on a certain page of a book." Several "write them a few times." Association helps. A college student writes, "I associate figures with what is familiar. If I hear that Mr. A. receives \$5,000 salary, I say to myself that is 5 times as much as my old school teacher got. After this the salary is easily recalled." Place localization, and association are chiefly relied upon. Some have a kind of mnemonic system, and group or reverse the numbers. One associates the figure 8 with a doughnut. 3.1416, the ratio between the diameter and the circumference of a circle is fixed by serial association, repeating the figures in order. 3.—1.4.1.6. (3, one 4, one 6). The same aids are employed for dimensions. The most efficient mnemonic aids for dates is to associate them with important events, *e. g.*, 1492, 1776, etc. Dates of minor importance are associated with these. Charts are recommended. Some make rhymes for dates, getting the idea, perhaps, from the way the presidents or the rulers of England are remembered. One sees figures in a winding row.

Faces are recalled by types. After fixing the type to which it belongs, the eyes, hair, nose, cheek-bones, complexion and scars are noted. A college student writes: "I try to trace a resemblance between a strange face and one I know." A middle aged woman takes careful notice of the hand. She has a poor memory for faces, but can often locate the person by the hand. A normal student writes the initial of the person or place on the left hand. After it has been erased she still visualizes it there. One analyzes the features. "If any feature resembles a well known face it is easily recalled."

Microscopic structures and crystals are fixed by drawing them. Drawing is the chief aid. Here, too, clear visualization counts. "I see them floating before my eyes." Localization in place is a help.

Leaves are remembered by the form, color, number of lobes, the veining, margins, and by comparing them with other leaves. Figures of wall-paper and carpets are associated with the room, house, or are localized in time. Here forms are also fixed by drawing, "even by tracing them in the air." The color, shape, and above all striking characteristics of figures are noticed.

Phrases in music are recalled by playing, or by attempting to play, or by humming the tune. College student, m., age 22. "I recall the time intervals and note the first part of the theme; I recall the rest by association." Female, age 17, normal student writes: "I remember phrases in music by thinking if they are similar to phrases in any selections that I have heard." Constant repetition and association of the selection with the person who played or sang it are helps frequently used. "If I get one measure as tone,—be it first or last,—the rest comes without effort." Female, age 34, recalls sounds, not appearance of notes. Her memory for sounds was strengthened by taking music lessons. One recalls music by an imaginary curved line going up and down with the tone. One thinks of whole rests as heavier than half rests, and consequently falling below the line. One boy thinks of the notes as Chinese climbing a fence. With another it is secondary automatic,—“my fingers remember the music.” The Indians find that sheer determination helps them to remember music, as other experiences.

The negro males gave,—by sound, visualizing, position of notes on the staff, some initial note is the key to the whole, music just comes up. Negro females remember (a) phrases in music by accent, (b) by sounds, time and words, (c) where they saw them last, (d) by mental picture of the notes. The familiar mnemonic sentences are given for sharps, flats and keys: "God deluged all earth by floods," "Foolish boys eat

apple dumplings greedily," "Fred Coburn goes down after each boy."

It is worthy of note that some excellent musicians recall music better after an interval. They cannot immediately reproduce it if they have enjoyed it intensely. Sometimes an interval of a day or two is necessary in order to recall it well. It is quite possible that there is a modification of the basilar membrane which serves as a basis for subsequent recall. Furthermore it is true that many people find that a time interval is necessary to recall well any experience. E. C., f., age 17, recalls better now what happened in all school grades than when she was younger. Male, age 20, "I can define and locate my former experiences better now than I could a year or so after they happened." Female, age 19, "I can recall now things that happened 8 or 10 years ago, which I could not recall 4 years ago." Apart from a maturer mind perspective seems to be necessary to many in order that they may have a good memory.

The cut of dresses is recalled by association with the person who wore the garment. New features are noted. The different parts, as neck, yoke and skirt, are studied by one. Association with place and person is the chief aid.

Passages of prose and declamations are memorized by paying attention to the thought. After the thought is fixed it easily clothes itself in language. Not a few, however, memorize mechanically, attention being especially paid to the beginnings and endings of sentences. Repetition and reading aloud are frequently mentioned. Clear mental representation and a purely local memory are of service. Male, 17. "I usually memorize by imprinting the object and its surroundings on my mind like a negative. In memorizing Lew Wallace's "chariot race," comprising 16 pages, I read it through twelve times. I imprinted the photograph of the page on my mind, and then read what I saw." In poetry the answers bear out the conclusions of Ebbinghaus and Müller and Schuman, as to the influence of rhythm. It plays the chief rôle. One is aided by fixing upon the initial letters of each line. Another gets the thought, "and the words which are so closely associated with thought in poetry come of their own accord." Repeating aloud is of service, but form and structure are usually mentioned as the essentials to be considered. Practice improves. One learns easily who memorizes a selection every day and rehearses all at the close of the week. A college student writes, "first of all a feeling of confidence is necessary in all recollection. Doubt breaks the train." The memory must be trusted.

Much the same suggestions are given as to the manner of memorizing fine passages. Slow repetition aids one or two.

The reasons given for memorizing these passages are (a) beauty of thought, (b) beauty of expression. "The author expresses the thought better than I can." "When depressed these beautiful passages come up and encourage me." Other reasons are: "To enrich my mental life," "prevents day-dreaming," "convenient when no book is at hand," "for pleasure and enjoyment" is an answer repeated frequently.

Few devices were given for fixing forms and phrases of foreign languages. Comparison with similar phrases and forms in the mother tongue is found to be serviceable. Even where the native language is as poor as the Indian this device is found useful. The less familiar are associated with the better known. The beginning of the list of German prepositions, *aus, bei, mit, nach*, etc., are associated by one with the phrase "the house by the meat-market."

A large number of devices are given for keeping appointments. Females change rings, insert paper under a ring, pin paper on dress, etc. There are other favorite mechanical devices. Chairs are turned over, and other furniture disarranged. A middle aged man hid his hat to remind him of an appointment. Next morning he hunted up another hat, but did not recall why the one usually worn was gone. One associates appointments with the hands of the clock at the hour fixed. Not a few find it necessary to repeat the appointment again and again. Others are aided by a memorandum. As a rule those who say that their memories are utterly untrustworthy do not use notes. Yet W., m., age 26, writes that the only appointment he has missed for years is one which he noted down. Female, age 16, writes, "to keep an appointment I write the first letter of the person or place connected with the appointment on my left hand. Even if it be erased I still imagine it there." Clear mental representation is the great help in such cases. Three visualize in colored terms. Female, age 19, recalls the letter A in black on red background. Female, age 21, "words seem colored. My name is red, my sister is yellow. I often remember by color." Male, age 18, "I remember figures by color."

There is a wide diversity of opinion as to how full notes a student should take, and almost all degrees of copiousness are indicated. Female, age 37, believes her memory was injured by taking full notes at the normal school. Again, "too many notes make the general idea of the lecture indistinct." One writes that the state of his health determines how full notes he takes. If the physical tone is low he is obliged to take more copious notes. Some are best aided by jotting down the headings and by giving attention unreservedly to the lecture. A normal student writes out very full notes, and never thinks

of the contents of the lecture until she leaves the lecture room. Some take "key" words with which the rest is associated. Concentration of attention and "hand and arm" memory are required as a rule by taking quite copious notes. To take few notes is a work of art, and the essentials must be seized upon. The consensus of opinions received would seem to favor few notes. Where full notes are taken they are not often reviewed.

The inquiry: "how would you teach a boy to remember things on time?" brought out a large number of specific directions, many of which were of a nature to make the fate of the lone Indian attractive by comparison. The normal students would have him keep a memorandum book; deprive of some pleasures, give tardy mark; keep after school as long as late; exclude from class and association with other pupils; if late at dinner, give very scanty meal; write down and fix things for him to do in a natural order; mark o; be on time myself for an example; make him go and get what he had forgotten; tell him true story of boy in trouble on account of forgetfulness; punish if late, and reward for being on time; make him do two or three times as much when he wants to do something else; study the boy; exclude from school; make him write the thing forgotten 20 times; have him repeat what he was to do and when; make him take the natural consequences; whip; lecture; strengthen his memory by having him commit poetry; have him write several hundred times what he had forgotten; give him tasks to perform that could be done only at one time; teach the sin of forgetting; try to interest him; first, ask why, second, keep after school; strengthen his memory by giving him short lessons to learn; show him how it would affect his father's business if his father were not on time; "I once told a forgetful boy to be sure and forget, and if he did I would give him a pretty card. He remembered."

The academic and collegiate students favor corporal punishment. One states that it worked well when he was a boy. The Indians also suggest this remedy. A very sensible suggestion comes from a college woman: "If a boy could not remember things on time, I would try to give him opportunities for practice; I should try to form an association between the thing to be done and the required time or something which would happen then." The suggestions to study the boy, and make him take the natural consequences; try to interest him; and ask him why, are good from a pedagogical standpoint.

A large number of young people state that they store up facts and dates with no definite idea of how they will use them. This statement applies more to facts than dates. It is a trait more characteristic of young men than young women. Male,

age 20, writes: "I collect facts as I would dollars, expecting to use them in many different ways." While peering into the future, and uncertain as to what resources shall be called out, the young man stores up facts from all sources, with but little thought as to their use.

In reply to question 12, instances are frequently given of a tenacious memory for history or literature, accompanied by little ability for original thought. Such students are usually deficient in mathematical ability. One young girl learns a page easily, but she has to recite it in order, or all is a blank to her. Male, age 19. Recalled all that he heard or read, but his conversation and writings were masses of quotations.

On the one hand it is recognized that a rich mental life is impossible without a good memory; on the other, very complete association is often attended by poor constructive power.

The request made under heading 13 of the syllabus called forth a wealth of material. Certain cases due to abstraction are as follows: A young lady went to telegraph for an umbrella left on a car; she had been holding it over her head for 30 minutes. A lady walked into the parlor with a \$10 bill in one hand, a match in the other. She put the bill in the stove and saved the match. A college professor forgets to eat his meals. A boy broke his ribs, and forgot all about it in two days. A man picked up a pebble and put it in his pocket; took out his watch and threw it into the ocean. A lady tried to tie her horse with the blanket and cover him with the line. A boy returned from the store three times to find out what his mother wanted. A lady was called away by an important message before breakfast, forgot until late in the day that she had eaten neither breakfast nor dinner. Gentleman, age 50, came down from his study and asked his wife if she knew where his pen was, he thought the children had mislaid it. She told him if he would take it out of his mouth he would talk more plainly. Boy, age 9, sent to store for extract of peppermint, brought paregoric; sent back with a bottle labelled peppermint, brought vanilla; third time sent he brought the peppermint. College professor, expert in numbers, is frequently seen with one black and one tan shoe on. A minister became absorbed in a book and forgot that it was Sunday. Man walked home and left his horse in the village all night. The same man went home from church and left his wife.

A great share of cases of lack of memory are due to abstraction, or to absent mindedness, which Mach terms "present mindedness." It often characterizes people of great ability along narrow lines of thought. The following is an instance of lack of memory due to fatigue: Female, age 22. "At the age of 16 I had been travelling all day, I went to the ticket

office at the last change of cars, but could not think where I was going, yet I had lived in the town 16 years.

There are a few instances given in which loss of memory is due to distraction. A middle aged woman heard of her son's death by drowning. She could not remember her husband's address in order to telegraph him, although she had written there hundreds of times. "Aunt recalls nothing that happens since her husband's death."

Defective memory in children is ascribed to things known. There are many instances reported in which forgetting occurred in the field of things done, many of these cases, however, are evidently cases of temporary forgetfulness due to abstraction. All of the Indians, with a single exception, state that things known are most easily forgotten. As to abstraction, no period of life is free from its influence. Not a few draw comfort from the facts frequently cited, that Samuel Johnson, when he had stepped from the sidewalk would continue for a long distance with one foot in the gutter and one on the walk; that Pestalozzi did not know enough to put up his umbrella when it rained; that Sir Isaac Newton supposed he had eaten when he saw the chicken bones on his plate; and that Edison forgot his wedding day. Still the fact remains that no period of life is free from noticeable abstraction. The boy with book in hand forgets to go to dinner after he has rung the bell; the young woman goes to different parts of the house, she knows not why; middle age hunts for the thimble on its finger, or the pen in its mouth; while old age is troubled that it cannot find the glasses on its nose.

Loss of mind and heredity are much less frequently cited as causes of forgetfulness than abstraction or distraction due to disease.

The fourteenth question was very abstract, and in some instances was evidently misunderstood. The answers came chiefly from young people. Of those who apparently answered in an intelligent manner 140 believed that the interval between being aware of an experience and the ability to define, locate and name the experience grows narrower as we grow old. Often the period up to middle age only is considered. One qualifies the statement "until old age;" two state that this is true until college is reached; while many consider that it holds until middle age. Not a few of the replies are the outgrowth of individual experiences, and would not apply after the age of 20 or 22 is reached. 125 state that the interval grows wider. Several state that this is especially true of middle age. The fact is recognized in the returns that the interests of middle life are greater, and the range of one's acquaintances is wider, and that this influences the interval necessary for recognizing and

defining an experience. This may not be the only factor, but it seems to offer, at least, a partial explanation. A fruitful field of inquiry is thus opened up and the ground broken. Prolonged and painstaking study of this problem may be richly repaid.

The writer acknowledges his indebtedness to President G. Stanley Hall for his unremitting interest and helpful suggestions, to Dr. E. C. Sanford for practical plans as to working up the returns, and to Dr. Burnham for criticism. He is deeply indebted to the many educators in colleges, normal schools, academies and high schools, for returns sent to the questionnaire. Their unselfish work remains as a most pleasing recollection. Mention must be made of Miss Lillie A. Williams, of the Trenton (N. J.), Normal School, for a great amount of excellent work; also of Miss Sarah W. Smith, of Medina, Ohio. A large number of papers were sent by President A. H. Heine-
man, of Haskell Institute, Ks., President Charles Meserve, of Raleigh, N. C., and by Booker T. Washington, of Tuskegee, Ala.

METHODS IN ANIMAL PSYCHOLOGY.

By LINUS W. KLINE, PH. D.

The differentiation of comparative psychology, as a branch and method to general psychology, has been comparatively slow. Its growth, however, has been natural and healthy, and its contributions to the study of mind are ever increasing in value. A complete historical account of this differentiation would be quite premature; yet it may be worth while to note in passing that several of the special problems of psychology,—for example: emotions, instinct, habit, heredity, etc., have been treated on very broad lines by such all-around scientists as La Marck, Brehm, Darwin, Kingsley, Wallace and Agassiz. A little later, men like Naegel, Huxley, Romaines, Lubbock, Graber, and Spalding, began to focus down and make experiments and observations on the senses, habits and intelligence of animals. Running somewhat parallel with these two groups of more purely scientific writers are the speculative and philosophic pens of Oken, Lewes, Spencer, Schneider, Weismann, Büchner, Cope and others who have evaluated and ennobled the facts of organic life by indicating their significance on the more serious and time-honored problems of mind and philosophy.

At present, definite problems, as the formation of association processes,¹ imitation, habit and instinct, are put to animals by playing upon some one or more fundamental instincts and taxic motions like those of hunger, sex, discomfort in solitude and prison, preferences for certain colors, geotaxis, chemotaxis, tonotaxis, etc. The ablest representative for psychology in this work is Lloyd Morgan, whose careful and critical interpretations of the objective manifestations of mind through bodily activities have done much to make comparative psychology reputable as a science, and even now essential to a comprehensive understanding of the more fundamental problems of mind. Wundt likewise has criticised to great advantage the usual erroneous and loose interpretations of animal activities. Criticisms of this type should not cease yet awhile.

The matter of interpretation at this stage, however, it seems to me is secondary. The most urgent need at present is more and better methods to get at the facts, which, when once discovered, will receive ample and proper attention.

¹Thorndike, Edward L.: *Animal Intelligence. An experimental study of the associative processes in animals.* N. Y., June, 1898.

The systematic study of animals thus far has been conducted along two lines: one, for a better name, we shall call the *natural method*. This consists in observing carefully and continuously the free life of an animal, for example: Huber, Moggridge, and McCook on ants, Audubon on birds, Figuiet on insects, Mills¹ on our domestic animals; the second line of work may be termed the *experimental method*. Here the animal is subjected to certain conditions essential in putting a question, and that favor the performance of activities that shall contribute material for answering a problem.

Both methods are necessary to a more abundant ingathering of facts. Both are frequently used by the same investigators, *e. g.*, Lubbock and Bethe² on ants, and Morgan on birds. Both have their share of errors and abuses. In the natural methods the cleverness of animals is sometimes overestimated, anecdotes of a questionable foundation are given too much credence. In the experimental method, conditions too artificial are liable to be created, thereby inhibiting the free expression of the animal's acts. Fear is too often present, dominating and modifying every act. A recent investigation makes exclusive use of the second method, which seems to me exposes the results to serious criticism. I shall revert to this investigation later in this paper.

Partly as an illustration of the use of these two methods combined, partly to reinforce observations already made, and lastly to present a bit of new material, I present the results of experiments and observations made on vorticella, wasps, chicks and rats.

VORTICELLA GRACILIS.³

The object here was to discover what activities, if any, have a psychological significance or value. The activities may be subsumed under the following rubrics: Self-preservation, reproduction, and "miscellaneous." The first includes all those movements, whatever, both of the whole and parts of the cell, exerted in food-getting, ejecting detritus, placing the mouth in a more advantageous position for receiving food, contracting the stalk to escape an enemy, or when cilia touch any large body, dead or alive, etc.

The reproductive activities need no specification. Miscellaneous activities include all those movements for which we can

¹ Mills, Wesley: *Animal Intelligence*. 307 pp. The Macmillan Co., 1898.

² Bethe, Albrecht: *Dür für werden Ameisen und Biemen psychische Qualit äten zuschreiben?* Pflüger Archiv für Physiologie. Bd. LXX 1898.

³ I am greatly indebted to Dr. C. F. Hodge for many valuable suggestions in carrying out this experiment.

assign no cause, *e. g.*, violent contraction of the stalk at a time when the field is free from any disturbing element that might be revealed by the microscope, food abundant, and body fairly well filled. Probably a study directed with a view to ascertain its chemotaxic and tonotaxic reactions would make some of these activities meaningful. I turn to the activities of self-preservation and note first the movements of the body as a whole. If the long axis of stalk and calyx is in and with a current of water,¹ the calyx is soon turned across the stream, forming an angle with the stalk. It is evident, owing to the well-known bell-shape of the calyx and the position of the cilia, that thus turning the bell would greatly facilitate food getting. Is there a psychical element in such a movement, *i. e.*, is the movement the outcome of the exercise of a psychical force? It appears to me that an affirmative answer is open to two serious objections: *First*, it can be explained in several other equally as plausible terms. The reaction to hunger alone is sufficient to account for the movement, and when we reflect that the habitat of *V.* is on grasses bathed by currents, natural selection might well be invoked as the principle that has impressed a reflex or mechanical movement of this sort on the cell. Then again, the inequality of the density of the current on the sides of the bell is a stimulus sufficient to cause a reaction expressed in movement (*tonotaxis*). Reactions of this sort occur in paramoecia,² hydra,³ frog, and the human conjunctive; *second*, to ascribe a directing role to whatever psychoses that may be present in these forms to activities of this sort, precludes further investigation—just as the “fiat creation hypothesis” of the middle ages kept men from enquiring into the more rational ways of world growth.

The mouth cilia are so directed as to either receive or reject small particles of matter. These activities have been championed as psychical. That the cilia do these things there can be no question, but that they are movements directed by a psychosis, *i. e.*, are really selective, expressing choice, is quite another question. Before this question can be scientifically discussed, it seems to me another question must first be determined, *viz.*: Have vorticellæ a choice in food—do they not

¹A current of sterilized water carrying yeast cells from a large flask was kept flowing under the cover slip. The water was drawn from the flask through a glass syphon, down to a capillary point, placed at one end of the cover slip, and a filter-paper drip attached to the other end. The microscope used was a Zeiss, apochromatic series, comp' ocular 12 objective 16 mm., which gave a magnification 190 diameters, and sometimes ocular 6, objective 4 mm. was used—magnification 375 diameters. The vorticellæ were found in great abundance from flags placed in an aquarium three weeks.

²Jennings, H. S.: Reaction of Ciliate Infusoria. *Journal of Physiology*, Vol. 21, 1897, pp. 258–321.

receive both digestible and indigestible material alike, and when filled eject both alike? It is a physical impossibility to receive even all the digestible material that comes their way. If given yeast they will receive 2, 3, or 4 grains at once and will then whirl the others away for 5, 10, sometimes 15 minutes before admitting any more. So that what has been interpreted as a selective process may be a reaction to "enough." To get facts that would answer the question one would have to first find a material¹ that they reject² altogether, then mix it with a palatable food, say yeast grains, and note their reactions toward the mixture.

I present in Table I the notes from my diary on a typical experiment with *vorticella*. It presents nothing essentially new or different from the work of Drs. Hodge and Aiken, save that yeast is a food for all the V. that I observed.

Again, do they discern between enemies and friends, between what is harmful and unarmful? If they do, we should expect to see the stalk contract in the presence of certain objects and remain extended in others or even remain in contact with them; and if they do not, we should expect the stalk to contract when the calyx comes in contact with any rigid, resisting, unmanageable object, organic or inorganic, dead or living matter. The latter condition is just what we do find. *Vorticella* takes no risks, trusts nothing, as it were, but contracts the stalk whenever the sensitive parts of the calyx or cilia meet with any resisting body whatsoever. I have observed the stalk contract when yeast cells and other food material came floating by in unmanageable quantities, or when the peristomal region came in contact with a large colony of bacteria—if the colony is small, they are hurled away by the cilia. I counted 118 stalk contractions due to the calyx hitting a dead leaf fibre. How long it had been reacting to this particular object, and how much longer it would have continued, had no accident intervened, can only be conjectured.

It seems to me all that we can say here is that the sense of touch mediates bigness, and persistence or rigidity, and reactions to such stimuli imply nothing more than simple mechanical reflexes.

Under the category of reproductive activities it is sometimes urged that the attachment of the free-swimming zoid near the base of the calyx is an expression of choice of selection on the part of the zoid, and therefore psychic. The zoospores of the cryptogamic world do equally as clever things in selecting

¹This problem was suggested to me by Dr. Adolf Meyer.

²The substance would have to be partly insoluble, at least in water, and of low specific gravity. I suggest pepsin, lycopodium powder, a few of the salts of calcium and barium, ground glass and the like.

the right oospore in which to penetrate. My fondness for mysticism and the "brand-new" is too feeble to urge me to invade the botanist's realm searching for psychological material.

The presence of a psychoses is not denied. There may be feelings corresponding to the stimuli bigness, rigidity or persistence, whenever the organism mechanically responds to such. All that I affirm is that these activities give no indication that they are the outcome of the exercise of a psychical principle.

Table containing the observations on Vorticella gracilis.

EXPERIMENT 12.

Date and time.	Contraction of Stalk.	Remarks.
Nov. 22, 7.00 A. M.	None.	Cilia moving slowly. Vesicle closing about 3 per min.
" 7.45 "	None. Stalk well extended.	Feeding occasionally. Takes in yeast grains.
" 8.05 "	Regularly.	Stopped feeding.
" 8.45 "	Feeble.	A swift current bearing yeast grains has just started up. The long axis of stalk and bell are in line with current.
" 9.00 "	4 x per min.	
" 9.15 "	Less frequent.	Feeding again. Taken in two yeast grs.
" 9.25 "	None.	Takes in yeast grs. occasionally, permits the great majority to go by after being twirled rapidly by the cilia. It is a physical impossibility to take in all the yeast grains that come by, or, for that matter, other food material. The food revolves around a common center. The diameter of each revolution of any one revolving food mass grows shorter. The food thus approaches the center, but not quite, as it gradually works toward the mouth when nearing complete digestion.
" 9.45 "	Once, when a large torulae struck the body near the mouth parts.	Feeding slowly. Takes in 3 or 4 yeast grs. at once, then sets them to revolving with the great mass of food.
" 9.55 "	None.	Has turned the bell almost at right angles to the stream, (the stalk is in line with the stream). This offers a better position for taking food.
" 10.00 "	None.	Two yeast grains, after making one revolution, were hurled out not seriously injured.
" 10.10 "	None.	Ejected yeast detritus, <i>i. e.</i> , cells that had been digested to a shapeless mass.
" 10.30 "	None.	Followed two yeast grains through one revolution; time, 4 min. and 45 sec., about.

Table containing the observations of *Vorticella gracilis*.

(Continued.)

Date and time.	Contraction of Stalk.	Remarks.
Nov. 22, 10.35 "	None.	A torulae of six grains rest on the base of the bell. V. does not move—in different to their touch. Heretofore, when a similar bunch was caught about cilia and lip, contraction of stalk followed at once.
" 10.45 "	Once, violent.	Threw off the chain of torulae at base. It had supported the chain 15 min.
" 10.55 "	None.	Revolution of food not regular. Sometimes it moves by jerks.
" 11.03 "	None.	The body has been distended with yeast grs. for one hour.
" 11.30 "	None.	Yeast cells in all degrees of digestion.
" 11.55 A.M.	None.	Body growing shorter and thicker.
" 12 M.	Regularly.	Body has two mouths—a clearance line can be made out. At one edge of the field V. No. 2, that has likewise been under observation from the beginning, is also dividing. Differed from V. No. 1 only in feeding; has eaten less yeast, digested all.
" 12.15 P.M.	Rapid and violent.	Division complete with No. 2, making two bells attached to the same stalk.
" 12.20 "	Irregular but strong.	At close of clearance No. 2 daughters were roundish, dumpy, now becoming more bell shaped.
" 12.45 "	None.	No. 1 has completed division. Neither No. 1 nor No. 2 have taken food for 45 min.
" 12.55 "	None.	No. 2 has begun to feed—taken in three yeast grains.
" 1.15 "	No. 2 violent and rapid.	No. 2 has lost her daughter. No. 1 eating yeast grains again.
" 2.00 "	Feeble.	No. 1 daughter bell detached. No. 1 throwing out digested material. Current has slowed up, yeast grains scarce.
" 2.15 "	Occasionally.	Cilia are developing about the base. Has stopped feeding, ejected most of detritus. Mouth cilia moving slowly and body elongating.
" 2.16 "	None.	Body rotating around stalk and quivering with violent action. Current nil.
" 2.18 "	Twice, violent.	Broken off from stalk and swimming away, having been under observation 7 hrs., 18 min.
" 2.30 "	None.	Current in region of No. 2 has run continuously.
" 2.40 "	None.	Feeding on yeast and other material that has somehow fallen into the current.
" 3.00 "	Occasionally.	Stuffed with yeast, body bent obliquely to the stream.

Table containing the observations of Vorticella gracilis.
(Concluded.)

Date and time.	Contraction of Stalk.	Remarks.
Nov.		
22, 3.15 "	None.	Yeast grains revolving—being digested.
" 3.45 "	None.	Ejecting detritus, taking in yeast grs. and other foods.
" 4.00 "	None.	Vesicle contracts about 3 x per min.
" 5.00 "	None.	For the last hour but little feeding, no yeast received, body filled with it.
" 5.10 "	None.	Food massed being churned, moved back and forth through the long axis of bell instead of revolving.
" 5.35 "	Once. Bell struck by a monster.	Filled like a balloon, takes in a yeast gr. occasionally. The great majority are made to pass on.
" 6.05 "	Feeble.	Food mass revolving again.
" 6.30 P.M.	Occasionally.	Body shortening and thickening.
" 6.45 "	Violent.	Second division has begun.
" 7.00 "	4 x per min.	Cleavage line distinct. Two mouths.
" 7.15 "	Few.	Division complete.
23, 7.30 A.M.		No. 2 still in the field—bacteria have developed during night to an alarming degree.
" 8.00 "	Every time cilia twirls bacteria or run into a mass too thick to be twirled.	Body well filled.
" 9.00 "	Violent.	Had stopped feeding for some time. Developed cilia and at 9 A. M. floated away. It had been under observation 26 hrs., 12 hrs. and 15 min. of which were constant.

WASPS. (*Polistes rubiginosus*.)

Sense of Smell.

The apparatus¹ consisted of a board 48 inches long and 15 inches wide, on which was built a glass hallway 18 inches long, 1½ inches wide and 1 inch high. One end of this long hall opened into two halls of similar dimensions, save their lengths, which was 9 inches. These short halls diverged from each other at an angle 70°. Both led into a single box, which was usually kept dark. These short halls I called "forks." The floor and top of the halls were glass. The odor was dropped on cotton batting the size of a pea. Odorous cotton was placed in the fork about 3 inches from the end of the long hall. At the same time the opposite fork contained a bit of odorless cot-

¹For valuable help and suggestions in the construction of apparatus and experimentation, I desire to thank Mr. Willard S. Small.

ton—the object being to present as far as possible similar conditions to the eye. The apparatus was placed directly in front and about twelve feet from a window. The end containing the dark box was kept toward the window. The wasps used were a large, reddish, yellow-bodied, black-winged social species, *Polistes rubiginosus*, sent me from Virginia. While being introduced into the glass hall at the end away from the light, they were handled by broad and *very pliable* forceps. Gentle handling *must* be observed. At the close of each experiment the halls were thoroughly deodorized. This requires much time. The experiment should be performed on bright days, and in a temperature not below 60 F. The following odors were used: asafoetida, bergamot, carbolic acid, cinnamon, cologne, oil of cologne, cloves, pennyroyal, tar, turpentine, violet, sassafras, alcohol and spearmint. I have copied below three experiments from my notebook, the rest are presented in tabulated form.

ODOR: CARBOLIC ACID. NUMBER OF WASPS USED: FOUR.

Odor on the Right.

Wasp No. 1. Stopped about four inches in front of the forks—rubbed antennæ vigorously with fore leg for about 30 seconds, then took the left hand fork to the dark box.

Wasp No. 1. Stopped about six inches in front of the forks and after much hesitation and turning back and walking nearly the whole length of the hall, he went in on the left side.

Wasp No. 1. Walked straight down left fork without halting.

Wasp No. 2. Stopped about four inches in front of forks, then turned back. Approached again, crawled back and forth from fork to fork; at last crawled up to the top glass of the right fork and crawled into the box back down.

Wasp No. 2. Much excited—mad—crawled right over odorous cotton and went in box via right side.

Wasp No. 2. Approaches forks slowly, much brushing of antennæ; at last takes left fork to box.

Odor on the Left.

Wasp No. 1. Went in via left—crawled over the odorous cotton.

Wasp No. 1. Went in via left, hugged the sides of the wall while passing the odor.

Wasp No. 2. Went via right, after much hesitation at forks.

Wasp No. 2. Went via left, but avoided the odor by hugging the side of the wall.

Wasp No. 3. Went via right fork after halting one minute at the forks.

Wasp No. 3. Went via right; seemed much confused.

Wasp No. 3. Went via left after much hesitation and turning back and forth; hugged the under side of the top glass.

Wasp No. 4. Went via right; seemed pure chance.

Wasp No. 4. Went via right after much waving of antennæ and examining both roads.

Wasp No. 4. Stopped at forks, started down left, recoiled, and crawled back to the far end of the gallery; returns, stops at forks, cleans antennæ, then goes via right fork.

SUMMARY.

Sixteen tests, thirteen of which showed conclusively that the odor was sensed, and eleven that it was objectionable.

ODOR : TAR. NUMBER OF WASPS USED : TWO.

Odor on the Right.

Wasp No. 1. Went via left fork ; pure chance.

Wasp No. 1. Went via left ; seemed not yet to have sensed it.

Wasp No. 1. Went via right ; gave no attention to tar.

Wasp No. 2. Went via right fork ; indifferent to tar. Cannot tell whether tar was even sensed.

Wasp No. 2 went in via right fork ; came out of dark box into right fork, walked over the odorous cotton ; seemed quite indifferent.

ODOR : ABSOLUTE ALCOHOL. NUMBER OF WASPS USED : FOUR.

Odor on Right.

Wasp No. 1. Halted four minutes about three inches in front of odor, brushed antennæ vigorously, then crawled up the side of wall of right fork and passed into dark box.

Wasp No. 1. Went via left fork ; this time seemed pure chance.

Wasp No. 1. Went via left fork, halted some time about two inches in front of odor, reared back, and finally took left fork to dark box.

Wasp No. 2. Turned down right fork, stopped about 2½ inches before odor, waved and stroked antennæ vigorously, reared back and plunged forward repeatedly, finally crawled in back down, on under side of top glass.

Wasp No. 2. Halted at forks, brushed antennæ, went in via left fork.

Odor on Left.

Wasp No. 3. Went in via left fork ; avoided odor by hugging the side walls. Was mad and excited.

Wasp No. 3. Went via right ; still mad.

Wasp No. 4. Walks slowly down gallery ; stops at forks, waves antennæ and strokes them vigorously ; then crawls up to the top glass and starts down the left fork ; stops just before getting to odor, turns back and forth in much confusion ; finally turned back and went via right fork.

Wasp No. 4. Went via right fork ; did not halt anywhere on the road.

Wasp No. 3. Started down left fork, stopped in front of odor for some time, then turned back and forth repeatedly, finally crawled in via left fork, hugging side of the wall.

Wasp No. 3. Went via right, did not stop at forks.

Put 3 and 4 in long gallery together. No. 3 crawled down right side, did not halt at forks, kept straight ahead to dark box via right fork ; and No. 4 stopped after entering the left fork, turned back and went via right fork.

SUMMARY FOR TAR AND ALCOHOL.

Tar may be sensed ; it certainly is not objectionable. The twelve tests with alcohol show that it is sensed and that it is decidedly objectionable.

Unobjectionable.	Objectionable.	Doubtful.
Tar	Asafoetida	Cinnamon
Turpentine.	Bergamot	Violet
	Carbolic Acid	Sassafras
	Cologne ¹	
	Oil of Cologne	
	Cloves	
	Pennyroyal	
	Alcohol	
	Spearmint	

Conclusions. (1) wasps readily sense odors; (2) some are much more objectionable than others, *e. g.*, spearmint caused the most violent reactions. They moved up and down the galleries as if frightened or pursued by an enemy; (3) some odors, as tar, turpentine, are not disagreeable; (4) there is much evidence showing that the sense of smell fatigues—more observations, made with the greatest precautions, are needed to make this conclusive.

CHICKS.

I used chicks of two incubations of about five weeks apart. The first group were returned to their rightful parent at about the age of eighteen hours. To the second group I was foster parent fourteen days, and from their standpoint many days longer, for they often ran joyfully to me and followed me when I went among the farm poultry. They knew no other parent. Both groups, which were cross-breeds of Plymouth Rock, Leghorn, and Minorca, were taken from the hen eight to twelve hours before they had pecked through their shells, and kept awhile in warm water and then transferred to an incubator.

Group one, consisting of two little birds. At the age of four hours I placed them on a large newspaper spread on the floor. Their repeated efforts to stand erect invariably resulted in their toppling over sometimes forward, sometimes backward to a complete somersault. The tarso-metatarsus (featherless portion of the leg) does foot duty at this age, so that the distal end of the leg when standing is the tibio-tarsus. Walking is really running, darting forward from 16 to 30 inches and ending in a sprawl. After attempts to stand or walk, they take cat-naps.

These naps occur every few minutes, during which time the neck is stretched at full length on the floor and the head resting on one side. They nap most frequently in direct patches of sunlight. On awaking, clumsy attempts are made to smooth out the matted down—their only feathers—which had been un-

¹It was thought that the objectionable element in cologne was the alcohol. The oil of cologne contains no alcohol, but they still avoided it, even though a very small drop was used.

kempt from the beginning. Only bright objects or strongly contrasted colored objects are noticed and pecked; large letters on the paper, bright threads in the carpet, at crawling flies, but with no success; bits of white pine, at their own and each other's toes, and at each other's bills, eyes and combs. At times they try to hover or cuddle under each other. I hold my hand over them under which they huddled close together. They act similarly toward almost any object held gently to their backs and heads—a stick of wood, a flannel rag, a shoe, a sock, a tin pan.

Age, six hours. Gave them crumbs of dough and bits of egg shells at which they frequently pecked but very seldom swallowed. They seized fairly well whatever they aimed at, but seemed to have trouble in holding it and getting it adjusted for deglutition. They follow, although their pursuit is interrupted by frequent falls, any comparatively large moving object: a hat, a folded garment, a tin pan, the cat, a person. I walk by one piping the want note, which by the way is their earliest and most frequent note, to a doorway ten feet distant, pass through the doorway over a sill ten inches wide inclined at an angle of fifteen degrees, the lower edge one and one-half inches high, into the next room and step behind the door. The chick makes the door sill in two runs, and to my surprise gets upon and over the inclined door sill and enters the room to a distance of eight or ten feet, looking and piping to the fullest capacity of its voice. Finally it takes a nap.

Age, eight hours. One swallows a dead fly after mangling it. I clap my hands close to their heads, make a loud hissing noise, they take no notice of either noise. I thrum on a guitar; this startles them, but they settle down so soon as the noise ceases and sleep, especially if the thrumming lasts from 30 to 45 seconds. Later they chirp the want note vehemently. I sneeze—they stop chirping for some seconds. Striking a pan has the same effect.

Group two consists of four chicks. Chicks Nos. 1 and 2 born August 28, 4 P. M., No. 3 August 29, 11 A. M., and No. 4 at 3 P. M.

17 hours old. August 29, 9 A. M. Nos. 1 and 2 now 17 hours old are placed in their poultry yard, 4 ft. wide, 5 ft. long and 2 ft. high—built in an attic with southern exposure. I give them cracked wheat, bits of half matured maize. They peck at the larger pieces of food and succeed in getting them into their mouths, but allow them to fall out. At last No. 2, the larger and brighter of the two, after making three trials to swallow a half a grain of wheat succeeds in the fourth attempt. They do not confine their attention long—15 seconds to about 30 seconds—to the different foods, in fact they are more con-

cerned about the objects in their new quarters. Everything attracts them with about equal force. They have had no experience from which to form preferences. (17 to 18 hours old.) Accordingly all objects within reach must be examined—the large letters and figures of the newspaper, the cracks in the floor, the wood work of their yard. They follow moving objects occasionally. The walking mechanism is fairly co-ordinated and under control. They never topple over backwards, and rarely tumble while moving forward. Loud and sudden noises shock them—not quite fright, for they never try to escape. Banging on a tin pan, thrumming a guitar, tooting a horn, clapping the hands, causes them to start, squat and shudder.

2 P. M. No. 2, 22 hours old, catches and swallows a wingless fly. I drop an earth worm (*Lumbricus*) before them. No. 1 looks at its serpentine movements, steps back skittishly, and gives for the first time the well known danger churr, approaches the worm, pecks it, wipes his bill, pecks again and then lets it alone. I give them two more worms. No. 2 spies and approaches one, strikes it twice, wipes his bill, and lets them alone. Their bills are yet too weak to seize earth worms.

4 p. m., chicks one day old. I heard an unusual piping in my poultry yard. No. 2 had jumped out of the warm box—a feat five inches up and a fall fourteen inches—into the yard. He is now the sole occupant. When I approach he scurries behind the box and crowds close up in the corner of the yard. This is the first time that he seems afraid of me, or has shown signs of genuine fear. I drop earth worms in the yard a second time, both show signs of fright and do not even peck at them.

No. 3, born 11 A. M. Placed it on a newspaper at 3 P. M. Its efforts to stand, walk and swallow, closely parallel those of 1 and 2. It made three attempts to follow me, and one to overtake an old garment folded up and dragged slowly by it. I did not permit it to overtake the garment. Later drew it by several times, but it took no further notice of this garment. It sleeps when not molested.

No. 4 or "the lonely chick," born August 29, 3 P. M. This chick is completely isolated from all others of its kind for four days less eight hours. His food is confined to bits of half matured maize and occasionally cracked wheat and water. Of course he gains a knowledge of the food qualities through experience by pecking at the several objects of his prison, *e. g.*, specks in the carpet, nail heads, rollers of table, large letters in the newspaper, etc.

Second day. August 30, 7 A. M. No. 2, as before, has jumped out of his box and shows signs of fear at my approach,

but when I hold out my hand he runs to it and eagerly surveys it. Yesterday he avoided his excrement after four experiences pecking at it. This morning he shows evident signs of disgust at the first trial.

9 A. M. I place a tin of water on the floor. All three run up and peck the brighter portions of the vessel while walking around it. I trouble the water gently by rocking the vessel. No. 2 sees the ripples, stretches his neck to examine, at the same time stepping back and uttering the danger churr. This is not at the motion of the tin, for they have been accustomed to this all along. When the surface of the water quiets, No. 2 approaches and begins pecking at shiny places as before. In doing this he throws a bit of cracked wheat lying on his head into the water, he seizes and swallows it as usual and smacks his bill, as if tasting, then thrusts it into the water up to his eyes, turning his head up he drank after the characteristic chick fashion. This was an entirely new movement, for bill, head and neck. It was executed to perfection. He dips his bill in twice more and as deep as before. This seems unpleasant, for he walks away hurriedly each time and wipes and scratches his bill. A bit of spider web thoroughly filled with wood dust bored out by a bee fell into the yard. No. 2 pecked at it six times. It gives him no satisfaction. He let it alone. Nos. 1 and 3 then give their attention to it. They soon desert it.

10.30 A. M. Offer them water a second time. No. 1 discovers it for himself somewhat as No. 2, *i. e.*, by pecking at a speck on its surface. Both 1 and 2 now drink together. No. 3 steps up and watches the motions of No. 1 in a single act of drinking. He immediately begins to drink. No. 2 has learned to thrust his bill in at the ordinary depth. I offer them an earth worm for the third time, this time as food, in my hand. All come up and look in. No. 2, who leads in everything, sees it crawling, gives the danger note, at this the others look more intently, then all walk away. They fear more things with age. Sounds that yesterday were unheeded are to-day listened to with surprise and fear. They shy away short distances whenever I approach. My hand, to which they have become accustomed, brings them back. Evidently they have not become acquainted with my body as a whole.

4.30 P. M. I give them bits of yellow pine in one portion of their yard and cracked grains of yellow maize in another. The morsels of food look not unlike. They eat the maize as usual. No. 2 seizes a bit of pine, fumbles it in his mouth, drops it, tries another, drops it likewise, and pays no further attention to the wood. No. 3 tries three different pieces before swal-

lowing one. He swallowed two bits, then turned to the heap of maize.

5.30 P. M. I gave them bits of starched muslin cut about 1 mm. square from old collars and cuffs. All three attack the little pile eagerly. No. 1 swallowed a piece; No. 3 ran off with quite a large piece; the others gave chase. This heightened, apparently, the desire of each to secure it. They snatch it from each other's mouths until No. 3 despatches it. They return to the muslin, look at it, pick up pieces lightly and drop them. Their appetites for muslin soon quail. It was the last that I persuaded them to eat. Competition even at two days old spurs them on to more prodigious tasks. No. 2 has tried repeatedly to swallow a whole grain of maize, but without success. No. 1 attempts to snatch it away. The grain passes back and forth from mouth to mouth, while chasing each other around the yard, until finally No. 2, although hard pressed, makes an unusual effort to swallow it and succeeds.

4 P. M. No. 4, the chick in solitude now one day old, is offered a tin of water. Gives it no attention. Drop food near the sides of the vessel, and later a few bits in the water. It seizes the food on the water, thereby getting water in its mouth. The stimulus touches off the drinking apparatus, for it at once goes through the drinking movements. But the water seems to frighten it very much. It runs off some distance; wipes its bill repeatedly. I coax in vain for it to return to the tin of water.

Third day. August 31, 9.15 A. M. I give Nos. 1, 2 and 3 green cabbage worms for the second time. No. 2, as usual, gave danger churr, all walk away. They still fear earth worms. Nos. 1 and 3 contend over a bit of muslin, but soon neglect it. I threw them several bits of muslin—all came up and looked at it and then walked away. They treat pine wood similarly. Show joy when I sprinkle wheat and Indian meal on the floor by running up and flapping their wings. They devote more time to preening their feathers and stretching in the sun. I thrum the guitar as on first day. No. 2 scurries away behind the warm box, and 3 runs and squats as if hiding. I wave the guitar over the yard once. No. 1 runs screaming to the farthest corner and tucks his head under the edge of the paper that forms the wall to their yard. A wasp flies against the window, No. 2 gives the danger sign, the rest listen. A sailing cloud throws a rapidly moving shadow across their home, it frightens them very much.

10 A. M. No. 4, now nearly two days old, is again offered water. It looked in the vessel then walks away, did this three times.

September 1, 8 A. M. Nos. 1, 2 and 3 still avoid earth

worms, caterpillars and green canker worms. They learned to drink milk yesterday in much the same way as they did water. They show no sign to-day of having seen it before. They approach it cautiously, peck around the edges of the tin for six minutes, and after much stretching and craning of their necks in looking at the milk, begin to drink it. Their experience with the white boring grub is interesting. Nos. 1 and 2 are afraid of it, No. 3 seizes the grub while curled up, looking not unlike a grain of corn. No. 1 gives chase, and, as usual, the desire for the worm is increased until No. 3 swallows it. I give them three more grubs. The grubs begin crawling, and so long as this is kept up the chicks give the usual danger note and crane their necks forward in fear and wonder. The smallest of the grubs stops crawling, No. 3 seizes and swallows it at once. This, I judge, encouraged him to try the second largest. No. 2, by imitation, seized the largest grub, which I had considered too large for them to swallow. The others endeavored to share so large a morsel with No. 2. This precipitated quite a tussle, which ceased by the lucky one despatching the grub.

12 M. I take Nos. 1, 2 and 3 on an outing, as it were, of one hour and forty-five minutes, into a large grass plot. While here their behavior, more than ever, impresses me of the great importance that experience plays in their acquaintance with the chicken world. They were unusually active the entire time, pecking at the different grasses, seeds, sticks, dried leaves, bees, crawling ants. The bright husks of the pepper weed and the seeds of the short wire grass received their first attention because of their brightness. I concealed two black watermelon seeds under a tuft of grass, farther on a yellow seed, and in a third place the seeds of a cantaloupe. They discovered all three in due time—each discovery was attended with notes of surprise, and the investigation set out with cautious pecking. It seems that their nerves are keyed for responses to every stimuli of sight and sound, that their organism is essentially nervous, responding and adjusting to a novel environment. No. 3 spied an earth worm coming out of the ground. He seized it at once, and pulled and tugged at it not unlike robin red-breast in a similar feat. This was the first earth worm eaten. No. 4 (the lonely chick) is not thriving like his congeners. His body is becoming short and rounded, "dumpy;" the head is drawn in close to the body. When not eating he pipes the lonely want note. His efforts to make friends with a half-grown cat was an amusing performance. Its first advances were met by gentle soft taps from the kitten, for which attention it chirped the satisfied note, and made repeated attempts to cuddle up in the kitten's fur. This appeared to annoy her felineship. She began moving backwards on three

feet, using a fore foot to bar the chick's too familiar advances. Her pats finally grew to taps, then to slaps, and at last to a severe box that sent the chick rolling over several times. This experience destroyed the chick's desire for further affiliation with the cat. Nos. 1, 2 and 3 after eating a full meal spend much time in making their toilet, basking in the sunshine and engaging in mock fights. These and other activities essentially chick-like, are the fullest and most varied after a sumptuous meal.

Fourth day. September 2d. They still show signs of fear when I drop a small earth worm before them. But this time No. 3 seizes one before it begins crawling. This whets the appetites of the others. I divert the pursuer's attention by dropping another worm, it is seized and carried to one corner to be devoured. They now seize small *moving* worms, but large *crawling* ones overtax their courage. They are now indifferent toward green cabbage worms, do not even show signs of fear in their presence. White grubs are attacked and eaten, if not crawling; the crawling grub presents a sight too hideous for them, even at the age of four days.

No. 4—the lonely chick—now nearing the age of four days, is brought from his isolated quarters to my poultry yard. He presents a dumpy, ill-conditioned form and a fretful, timorous attitude, yet always ready to eat. The three approach and station themselves in a semi-circle about the stranger. Nos. 1 and 2 give the astonish or surprise chuckle. All three stretch their necks and peer scrutinizingly at the intruder as if “to look¹ him out” of their presence. No. 1 advances and strikes him a severe blow on the head. He attempts to return it, but is struck again and seized by the head and pulled and jerked about in battle royal fashion. At this treatment he screams the shrill cry of distress and tries to escape from the yard. He is nagged for some minutes, and finally permitted to stand in one corner and utter those lonely piteous cries that he has been making ever since he began to walk.

I now distribute several kinds of food in distant parts of their yard, thereby increasing the unwelcome stranger's opportunities for getting his breakfast. He makes good use of the advantage, and snatches a morsel now here, now there. Although he is occasionally struck at, it is apparent that his presence is becoming more tolerable, and in time will be suffered to remain in peace. And so he was at the expiration of two hours with all four basking together in a parallelogram of sunshine. They lie on one side, stretch the free leg and

¹The reader will understand this phrase as merely descriptive of their appearance and nothing more.

wing at full length. So well at ease had No. 4 become that while thus stretched out on the floor, he raised the free expanded wing and fanned it gently back and forth showing every sign of comfort. This is the first time he has shown genuine contentment. It took companionship to make his life complete. I gave them grubs and earth worms, which were eagerly devoured, after which I offered them green cabbage worms. This was No. 4's first experience with worms of any sort. He had just witnessed the others eat grubs and earth worms with impunity. So when the green cabbage worms appeared, he did not hesitate to devour them while the others stood back or walked away. But his spirited and ravenous dealing with the worms induced the others to rob him of a worm—a lively chase ensues which ends in the competitors devouring fragments of the worm.

The only activity during their outing to-day (ages four and five days) that deserves notice is that of wallowing on the hard ground and shuffling the wings after the manner of full feathered birds when taking a sand bath. The motion of the wing, when sand is present, both gathers and throws the sand over the entire body not unlike a shower bath. The movement appears complex.

Fifth day. September 3, 7 A. M. Cabbage worms are offered No. 4 the second time. Nos. 1, 2 and 3 stand aloof. No. 4 eats one, wipes his bill vigorously several times, returns to the squirming heap, shakes his head. He never ate cabbage worms after that. My chicks have a peculiar way of shaking or slinging the head—as if in disgust, at the sight of an object disagreeable to their taste. Again during their outing they indulge in attempts to wallow on the hard ground. They made a similar attempt on the floor. They now appear to know their "outing grounds." So soon as placed on the ground they run and dart hither and thither and flap their wings, and engage in mock fights.¹ This usually begins by a sudden and simultaneous darting about and clapping the wings, and then rushing together giving each other light pecks. They are less timid, pay less attention to the various noises and sights about them, and wander farther away from me and from each other. When these little excursions isolate them the lost note is piped. They always find their way back. To-day for the first time they give evidence of wishing to perch in high places. No. 1, after walking around a basket, five inches high, several times and looking at its top, mounts to its rim, and as soon as he has balanced himself sits down. Later at roosting time he tries to

¹ See Wundt, pp. 357-8, and Karl Groos: *The Play of Animals*. D. Appleton Co., N. Y., 1898.

fly to a horizontal stick four inches high, forming a part of the yard's frame-work. He also flies up the side of the paper wall and pipes the distress note when he wants to go to roost. He invariably chooses the same corner of the wall over which he attempts to make his escape, and although he mounts only a very small fraction of the wall, his efforts never tire in covering that small distance. I offer them again bits of muslin and pine wood, which they have not seen for three days. The muslin is ignored, several pieces of pine are picked up and dropped by each one. No. 2 finally swallows a piece—the fifth that he had examined. He walks away and wipes his bill. Four days later I offer them pine wood. It received no attention this time even though I continued to sprinkle it before them as I do grain.

Sixth day. September 4th. After eating their breakfast, wallowing in fresh, loose ground and preening feathers, Nos. 2 and 4 engage in a mock fight. No. 4 sits on the bottom rung of a ladder, the top of which rests on the top of the yard enclosure, thus affording an outlet, should they make an effort to use it. This occurred at 8 A. M. At 8.45 No. 3 walks half-way up the ladder and sits down. No. 4 attempts to fly up to No. 3, but fails. No. 3 gets up and continues his way up the ladder; at a height of 18 inches he stops, looks about, both feet and wings tremble and quiver. Steadying himself, he turns around and descends the ladder to a height of 10 inches, sits down and completes his toilet in apparent ease. They now seize earthworms whether moving or crawling.

An instinctive movement was made by No. 2 at the close of his toilet exercise, that is both comical and instructive. After smoothing out the pin feathers of his breast and straightening out the sprouting remiges, he stretched up at full height, flapped his wings against his sides in approved gallinaceous style, and at the close of the wing movements swished and wiggled the little bunch of cottony pin feathers that occupy the place of the future tail feathers—a beautiful illustration of complete development and co-ordination of both nervous and muscular apparatus long before there is any need of their functioning; for the tail feathers over which these nerves and muscles have control did not show themselves until three weeks later.

Seventh day. September 5th. I notice that they are quite sensitive to changes of temperature. No. 1 stepped on a motionless earth worm. The foot was taken off with a sudden jerk. It had not noticed the worm. I laid a cold copper wire down, one stepped on it and immediately jerked the foot up. Their room has a southeast exposure. The first rays of the sun fall on the right wall of their yard about one foot from the floor. They spend much time in looking at the bright spot.

It descends obliquely to the floor, reaching it in about twenty minutes. They have now learned to stand ready waiting for the warm rays to fall on them. These September mornings are chilly. The direct sunlight reaches the left side of the yard by noon. They follow it up as it crosses the yard whenever they make their toilet or wish to cat-nap.

8.30 A. M. No. 3 mounts the ladder and climbs the rungs quite a distance, sits down at a height of 11 inches. Nos. 2 and 4 stand under him, stretching and peering their heads up, and try to fly up. It did not occur to them to walk to the lower end of the ladder and walk up. This is the third time that No. 3 has perched on the ladder, and every time 2 and 4 have tried to reach him by flight, standing directly under, notwithstanding too, that both have seen No. 3 begin his ascent at the end of the ladder.

5 P. M. No. 4 for the first time walks to the top of the ladder. This gave him a view of the world outside the poultry yard. He looked intently in several directions and at times uttered notes of surprise and the "wonder chuckle." He walked a short distance from the end of the ladder out on the top of the wall of the yard. He looked first on the outside, then on the inside, as if in doubt which way to fly. He finally flew down in his old yard. No. 1 for the past three days grows very restless at the approach of night and tries to escape as before described. He walks around the four sides of the yard; on reaching the fourth corner he attempts to fly over. He is as persistent in his efforts as a bee against a window pane. He has ample opportunities for learning to use the ladder, but pays no attention to it when he wishes to escape. All have taken a turn in walking up the ladder, save No. 2, who is very large for his age, with wings undeveloped. He never shows discontent. His fellows have small bodies but rapidly growing wings. They grow restless. No. 4 has made two more excursions to the top of the ladder. An outside ladder butts against the inside one at the top of the yard wall. No. 4 stepped on this ladder, walked down two rungs, uttered a cry of fear, stepped off backwards on to the inside one and walked down into the yard.

Eighth day. September 6th, 6.45 A. M. Gave them green canker (cabbage) worms. They gave the surprise chuckle, finally No. 4 seized one, then all gave chase until he swallowed it. All return to the worms, but refuse to take hold. They begin to clamor for food.

7.30 A. M. They have had a sumptuous breakfast. Preening feathers, mock fights and the like follow. No. 4 has walked to the top of the ladder four times since breakfast. He has stepped on the outside ladder twice. The others still watch

him as if they too would like to climb up. During the forenoon he climbed the ladder fourteen times. Sometimes he would step on to the outside ladder but never ventured to walk down. After his noon meal he walked up the ladder and out on the top of the poultry yard fence. He walked back and forth leisurely on the wall and while attempting to catch a passing fly he slipped off and dropped on the outside. He showed signs at once of desiring to return to the yard. He walked around and under the outside ladder. It was made exactly like the inside ladder and leaned against the wall at the same angle, but it never occurred to him to use it. During the space of an hour he walked back and forth along the wall thirty-two times, and put his head through a small crack, looking into the yard, thirty-eight times. Toward the end of the hour he became more reconciled to his lot and began to search for food.

Ninth day. For some time they have been pulling off bits of paper forming the wall to their yard to get the flour paste used in their wall paper. To-day they pecked and pulled at a piece that turned in until they made an opening large enough through which to escape. They walked out. I put them back. They went at once to work and pulled it in and up. Out they went again. This was repeated until I fixed it securely. I kept them in their poultry yard until the age of fourteen days. They never learned to use the two ladders as a means of egress and ingress, although I frequently put them through the movements of climbing one ladder and descending the other.¹

CONCLUSIONS.

1. Both hearing and sight are dull during the greater part of the first day. They develop very rapidly the second and third day, being highly sensitive on the third to any and all sounds and noises.

2. Pecking is better developed from the first than swallowing, in fact the muscles for holding the head erect, for controlling the jaws, and the process of deglutition are very weak the first 8 or 10 hours.

3. Fear increases with the development of sight and sound.

4. The instinct to follow soon fades out. Hovering and cuddling together are instinctive. Both Morgan and Mills seem to think that hovering under the hand or following it is due to the warmth it affords them. I find they follow any small moving object at first. Later the hand becomes a very interesting object; their attachment grows out of its being their only source of food.

¹To expect them to learn a task by forcing them through it, has impressed me since as a very artificial if not an actually absurd thing to do.

5. Mock fights begin the third day, and shade over into serious business the sixth week.

Wundt¹ regards mock fighting as the only type of play among animals, and interprets it along with Karl Groos² as a schooling to the serious struggles of adult life.

The different degrees of permanency of their associations suggest a problem for extended work among several species. They rejected pine wood after a few experiences at the age of three days, but three days later they ate it again, while experiences with muslin on the third day was lasting. They were six days getting acquainted with earth worms, and eight days with the canker worms.

They learn to do some things by imitation, *e. g.*, drinking, learning to eat certain foods, escaping from their enclosure, while other tasks of apparent equal simplicity are not learned. Though the fortunate one performs the trick before them every day. No. 2 learned to escape from the "warm box" at one day old, the others, more agile in most things, never learned the trick. I quit putting them into the box the fifth day. Dr. Thorndike³ inclines strongly to the belief that domestic animals do not imitate each others performances. This belief is founded on the results from experiments conducted exclusively on what I have called the *experimental method*. Describing his method he says: "It was merely to put animals when *hungry* in *enclosures* from which they could escape by some simple act, such as pulling at a loop of cord, pressing a lever, or stepping on a platform." The motives, then, played upon were hunger, desire for freedom, and surely in many cases fear—especially would this likely to be true with the young brought into novel situations. Imitative activities form a good part of play activities—not all play is imitation, nor *vice versa*, but much of the two are on common grounds, and find their fullest expression under similar conditions. What are these conditions? Just the opposite to those created in his experiments, *viz.*, freedom, security from harm, satiety, in a word—well being. Nothing so shrinks and inhibits completely the fullness and variety of an organism's activities⁴ than prison⁵ life⁶ and fear.⁷ Dr. Thorndike first teaches a chick to escape from a certain situation, then places along side of this one that "knows the ropes"

¹ Wundt: *Human and Animal Psychology*, p. 358.

² Groos, Karl: *The Play of Animals*. Translated edition, 1898.

³ Thorndike, Edward L.: *Loc. cit.*, p. 6.

⁴ Verworn, M.: *Pflüg. Archiv.*, Vol. L, 1891, pp. 439-440.

⁵ Cornish, C. J.: *Animals at Work and Play*, pp. 31-38, 1896.

⁶ Jordan: *Habits and Developments of Newts*. *Jour. Morphology*, Vol. VIII, pp. 269-366.

⁷ Kline, L. W.: *Am. Jour. Psy.*, Vol. X, No. 1, 1898.

others entirely ignorant, and says by his experiment "imitation if present will surely come forth." To get a particular tone from a musical instrument we must play on certain definite keys. Dr. Thorndike has played the wrong keys. It seems to me all that we can say at present is that some individuals of a species learn some things by imitation. I heartily agree with Professor Mills who finds wide individual aptitudes among members of the same brood, or family.

WHITE RAT.

The object of the experiment with the white rat was to ascertain its susceptibility to profit by experience, to test its quickness to learn by appealing to its most dominant and characteristic activity in food getting, the readiness with which contiguous associations are built up.

For this purpose stimuli was addressed to the rats' pawing and digging¹ activity by means of the following device: (1) A box 8 inches long, 7 inches wide, 6 inches deep, whose sides were of wire, top of glass and bottom of wood, was put into their home box, which also served for an observation box. At one end of the floor of the small box a piece $3\frac{1}{2}$ inches long and 2 inches wide was sawed out. The box was raised above the level of the floor by resting on two strips $1\frac{1}{2}$ inches thick; (2) sand and sawdust was heaped up loosely around the sides of the box until it rose a little above the level of its floor; (3) food (dog biscuit and cheese) was put in the box.

The observation box, containing two rats, was 18 inches long, 14 inches wide and 14 inches deep, one side was wire, one end glass, the rest of wood. The rats knew practically no other home, they had been reared in much the same sort of box. Before beginning the experiment I left the experiment box in their home several days, so that they had become quite familiar with it. Their exceeding timidity makes such precautions necessary.

Experiment 1. January 9th, 2 P. M. Both rats at once attacked the box, crawled up the sides, over the top, and went round and round in a very monotonous fashion—always smelling. They persevered nearly an hour. At 3 P. M. their movements were less decided, seemed more haphazard and indifferent. One gave up and returned to the nest,—the second, somewhat more frisky, began scratching the sawdust in that very instinctive fashion which I have observed them do under

¹I am not yet satisfied that I have appealed to its dominant trait or method of food getting. On *a priori* grounds I had thought that the gnawing activity was the best developed—a tentative experiment threw doubt on this and suggested the one used.

all sorts of conditions, even when they are well fed. It appears to be a "wild trait in a tame animal," as Robinson¹ has characterized such more or less useless instinctive performances among our domestic animals.

The hole thus accidentally dug happened to be at the end of the box where the piece had been taken out of the floor. The rat immediately poked its nose into the new opening which was not large enough to admit its head. It seemed to be frightened, ran to its hiding place, came out after about a minute, smelled cautiously about the hole, and dug away more material, then scampered away as before. These acts were repeated several times, until an opening quite too large had been made. It then ventured cautiously up into the box, snatched the food and carried it to its hiding place at 3.30 P. M., after working one hour and thirty minutes.

Experiment II. January 10th, 3.45 P. M. They behaved to-day much like the preceding, *i. e.*, climbing up the sides, walking over the top, except that they spent more time about the place where they had excavated the day before—seemed to have located the place in an indefinite sort of fashion. They frisked and fidgeted about 4 minutes, then one began digging with a will, and did not stop this time until the work was complete. But, as before, they hesitated to enter at once into the hole and box, they frisked nervously about for some time—coming up, peeping into the hole, then scampering off. At 3.53 P. M., or after eight minutes' work, one ventured in after the food.

Experiment III. January 11th. Set experiment agoing at 2.12 P. M. One came out of nest about a half-minute before the second. They did not climb up the sides and over the top of the box, but confined their movements about the place where they had made the burrow the two preceding days. After smelling around $1\frac{1}{2}$ minutes, No. 1 went to work and in a half minute a hole of sufficient size was made. This time there was no hesitation; it went right in. Snatched the food at 2.14 P. M. Time in getting food $2\frac{1}{2}$ minutes.

Experiment IV. January 12th. Experiment began 4.17 P. M. Rats came out immediately, climbed up side of box, then on to top, walked about sniffing the air, crawled down, and went at once to the usual digging place. At 4.20 it took food out. Time, 3 minutes.

Experiment V. January 13th, 4.15 P. M. Rat No. 1, only, came out. Approached the box leisurely, sniffed the air quite often. Stood erect, with forepaws against the box. Suddenly,

¹ Robinson, Lewis: Wild Traits in Tame Animals, 326 pages. Edinburgh and London, 1898.

as though the idea had just possessed it, it got down and began the usual excavation. Stopped when half done, walked away, came back, finished the opening, and took food at 4.18½ P. M. Time, 3½ minutes. The indifference manifested in this experiment I think is due to their being too well fed. No. 2 did not even leave his nest until No. 1 had started home with his food. It is evident that they have learned how to get their food (during the experiment it was given in no other way), and that they must have greatly profited by their *first* experience—the first attempt to reach the food required 1 hr., 30 min.; the second attempt, 24 hours later, only 8 minutes. I am not persuaded, however, that the elements in the associative chain, whatever the psychologist may decide their nature and number to be, have as yet taken on any very stable and clear form. They seldom begin digging at the proper place, sometimes will begin holes in several different places, and they will not dig at all until they have made several examinations of the box. All these preliminary activities may fade out in time.¹

The methods presented here enable us in a comparatively short time to point out more distinctly, and that, too, in an elementary way, the dividing lines between instinct,² intelligence, and habit, *e. g.*, it was instinct that prompted my chicks to perch, or my rats to scratch up the sawdust; it was intelligence gained through chance experience, that enabled the chicks to escape from the yard, and the rats to get food from the box; it was habit that made the chicks go in a particular roosting box, unsolicited, at the approach of night, while they were wholly indifferent to another box and would escape from it if put in it.

To Dr. Edmund C. Sanford I desire to express my best thanks, not only for suggesting the work itself, but for valuable help and timely suggestions at every turn during its execution.

¹ I have since performed 8 more experiments. The time has been reduced to 30 seconds, and many of the useless preliminary performances have been dropped.

² Morgan C. Lloyd: Habit and Instinct.

MINOR STUDIES FROM THE PSYCHOLOGICAL LABORATORY OF CLARK UNIVERSITY.

COMMUNICATED BY EDMUND C. SANFORD.

XII. ON NEARLY SIMULTANEOUS CLICKS AND FLASHES.

By GUY MONTROSE WHIPPLE, A. B.

Judgments of the time order of nearly simultaneous clicks and flashes have been studied by several investigators, but with discordant results. Exner¹ and Gonniesiat² find that the order click-flash can be recognized when the interval of time between the two stimuli is less than when the order is flash-click. Bloch,³ Tracy⁴ and Miss Hamlin,⁵ on the contrary, find that the order flash-click is the more easily recognized.

In explanation of this difference Miss Hamlin suggests, on the basis of her own and Tracy's work, that it "depends on the fact that series of pairs of stimuli were used in one case [Exner's] and single pairs in the other. In his experiments on personal equation Gonniesiat finds rhythm a very important factor, and it may have been effective in these experiments of Exner's." The present study has chiefly in view a comparison of the 'series' and 'single pair' methods when judged by the same subjects.

Apparatus and Method. The apparatus consisted of an arrangement for producing the clicks and flashes, and of a double set of switches, one of which could be used to cut out single pairs of stimuli for observation, when single pairs were under investigation, while the other served to reverse the order from click-flash to flash-click without altering the other parts of the apparatus. The arrangement for producing the clicks and flashes consisted of a double revolving disk of special construction, so arranged as to make contact for an instant in two in-

¹ *Pflüger's Archiv*, XI, 1875, 403-432.

² *Recherches sur l'équation personnelle*. Paris, 1892, pp. 138-140.

³ *Revue scientifique*, XXXIX, 585.

⁴ *American Journal of Psychology*, V, 567 f.

⁵ *Ibid.*, V, 564-575.

dependent electrical circuits.¹ One of the disks was fixed permanently upon the shaft of the instrument, and was divided into degrees; the other could be turned upon the shaft so as to alter the separation of the contact points (of which each disk carried one), and was provided with a vernier, by means of which the setting of the disks with relation to each other could be read to one-tenth of a degree. These disks were driven at the required speed by a small electric motor, the speed of the motor being properly reduced by the interposition of gears and pulleys. The actual clicks were given by a telephone, and the flashes by a Geissler tube and induction coil, both controlled by the instrument just described. The tube was encased in a blackened box, but seen directly through a horizontal slit 115 mm. long by 6 mm. wide. The room was partially darkened during experimentation.

It is hardly to be expected that an apparatus driven in such a manner by an electric motor should be wholly constant in rate. Careful timing showed a difference in rate of about 0.1 sec. per revolution,—from 899σ to 796σ,—during a five minutes' run of the apparatus. This, however, is less important in the present instance than the irregularity from revolution to revolution, which was such as to give a maximal mean variation of 10.9σ in an average of eight determinations taken at random from the records of a single minute. This variation is larger than could be wished, but as the contact points of the two disks were never more than 27° apart, it involves a variation of only 0.8σ in the time values of interest for this study. This variation makes the measurements rough, but leaves them of sufficient accuracy, it is believed, for the questions to be determined.

The time for any set of tests was found by calculation from the setting of the disks and the time for 100 revolutions of the disks taken with a stop-watch giving fifths of a second.

The rates at which the pairs of stimuli recurred when they were used in series were approximately: one-half, one, two, three and four seconds. Ten consecutive pairs were included in each series. When single pairs were used the intervals from test to test were taken at the operator's convenience.

The method of right and wrong cases was employed, the subjects being given an equal number of click-flash and flash-click orders irregularly mixed, and being required to register

¹ While the instrument was arranged for two independent circuits, it was found simpler in use to make the two circuits partially coincident, and by proper wiring to use only a single battery for producing both clicks and flashes.

an answer one way or the other each time, guessing, if in doubt.¹

The number of trials given at each rate was never less than 100, and often more. The usual precautions against fatigue and expectant attention were taken, and to counteract the effects of practice, in part, each subject was given an hour's training before beginning serious testing. Part of the subjects, also, started at slow rates of speed, and part at fast. Of the subjects, C., P. and S. were accustomed to laboratory tests, the others not. S. had served also as subject for Miss Hamlin. The results of the tests are given in Table I, according to the subject, and in Table II in briefer form, according to the various rates of speed. In the first Table "kind" indicates whether a single pair or a series of pairs of stimuli was used. The second column gives the interval in seconds at which the pairs of stimuli recurred when the series method was used. In counting the tests each order presented was counted as one; thus 200 tests means 100 trials of the click-flash order and 100 of the flash-click order. "Time" is the interval separating the stimuli, given in thousandths of a second. The last two columns indicate the time necessary to give 75% of right answers, calculated according to Fullerton and Cattell's Table.²

In Table II, the results of these calculations have been collated to show at a glance the individual variations and the effects of the various rates of speed. The bracketed times represent the results of verification tests, being in each case a repetition at the close of the whole experiment of the particular form of test on which the subject began.

TABLE I.

Subject C.

Date.	Kind.	Interval in sec.	No.	Time.	% correct.		Time necessary to give 75% rt. cases.	
					C.	F.	C.	F.
Jan. 10.	Singles	—	200	74.1	67	83	114	53
" 12.	Series	3	150	15.6	70	93	20	7
" 17.	"	2	100	26.9	72	82	31	20
" 18.	"	1	100	40.0	66	78	66	35
" 24.	"	½	100	10.8	64	70	20	14
" 26.	Singles	—	200	67.5	63	62	138	150
Av.,								61 45

¹ Further experiments, by the method of minimal changes, are now in progress. Since their completion has been unavoidably delayed, and since the series taken by the method of right and wrong cases are complete in themselves, it seems best to publish this study at the present time.

² Fullerton and Cattell: On the Perception of Small Differences, Univ. of Penna., 1892.

Subject P.

Jan. 10.	Series	1	200	42.5	78	100	37	—
" 11.	"	½	200	42.3	72	80	49	34
" 22.	"	2	100	20.5	88	88	12	12
" 25.	"	3	100	13.9	78	90	12	7
" 27.	"	4	100	10.7	84	68	7	16
" 29.	Singles	—	200	25.2	83	81	18	19
Feb. 3.	Series	1	100	19.1	68	82	28	14
Av.,								23 17

Subject W.

Jan. 15.	Singles	—	200	69.4	60	89	183	38
" 25.	Series	4	100	10.6	94	96	5	4
" 27.	"	3	100	10.8	94	94	5	5
Av.,								64 16

Subject Ck.

Jan. 14.	Singles	—	200	76.4	74	77	80	69
" 15.	Series	4	100	16.4	64	80	32	13
" 26.	"	3	100	16.6	88	96	10	6
" 27.	"	2	100	21.8	74	92	23	10
Feb. 3.	"	1	100	22.5	72	66	26	37
" 4.	"	½	100	41.6	66	66	68	68
" 14.	Singles	—	200	45.8	81	94	35	20
Av.,								39 32

Subject Sm.

Jan. 14.	Series	1	150	38.7	78	86	34	24
" 15.	"	½	100	43.1	78	74	40	45
Av.,								37 35

Subject S.

June 11.	Series	1	100	35.0	74	90	37	18
" 11.	Singles	—	100	53.3	84	86	36	33
" 13.	Series	2	100	22.2	78	96	20	9
" 14.	"	½	100	34.8	72	84	40	24
" 15.	Singles	—	100	50.9	80	84	41	35
Av.,								35 24

An examination of these Tables will show that the results obtained, with few and unimportant exceptions, accord with those of Bloch, Tracy and Miss Hamlin, and are contrary to those of Exner and Gonniesiat; in other words, that the click-flash order requires a longer interval of time for recognition than the flash-click¹ order. In seeking for an explanation of her results, Miss

¹ The tendency to take the flash as coming earlier was noticed by some of the subjects themselves. Ck., for example, during one test said: "They all seem like flashes [first]. I have to work hard to make any clicks first." S. found it rare to get a click distinctly first, and hence answered "click first," for any cases where they appeared simultaneous or with the flash only slightly ahead. The flashes were commonly distinctly separate from the clicks when they actually came first.

Hamlin suggests in place of Exner's theory of optical inertia, that the stimulus of the greater attention-claiming quality will be apt to be considered first in point of time. With this view the writer of the present paper finds himself in full agreement.

TABLE II.

Subject.	Singles.				4		3		2		1				$\frac{1}{2}$		Av.	
	C.	F.	C.	F.	C.	F.	C.	F.	C.	F.	C.	F.	C.	F.	C.	F.	C.	F.
C	89	44	[138]	[150]			20	7	31	20	66	35			20	14	61	45
P	18	19			7	16	12	7	12	12	37	—	[28]	[14]	49	34	23	17
Wm	183	38			5	4	5	5									64	16
Clk	80	69	[35]	[20]	32	13	10	6	23	10	26	37			68	68	39	32
Sm											34	24			39	45	37	35
S	36	33	[41]	[35]					20	9	37	18			40	24	35	24
Average	81	41	[71]	[68]	15	11	12	6	21	13	40	29	28	14	43	37	43	28

The prominence of the flash in consciousness is further attested by the tendency, that nearly all the subjects noticed in themselves, to connect the click causally with the flash, which seemed to travel along the tube. If the click seemed at the end of the

tube where the flash appeared to originate, it was called first; if at the other end, the click seeming a result of the flash, like thunder after lightning, it was called last. Whether the attention-claiming powers depended on a greater intensity in the flash or a greater weakness, cannot now be said with certainty. The flash appeared to some to be a more intense stimulus to the eye than the click to the ear; to others the reverse was true. Most of the subjects felt unable to compare them. Meumann¹ found that a strong stimulus could catch the attention, and thus be placed earlier; Drew² that a faint stimulus had the same effect. Probably both tendencies are found under different conditions. It appears most probable that the weakness of the flash, or rather the necessity of attending to it, is the factor most effective in these experiments. The flash necessitates accommodation and a watching of the box; while the click seems to force its way into consciousness unaided. It would be interesting to repeat the experiments with a visual stimulus arranged to illuminate the whole visual field with a sudden glow, so that the elements of visual attention could be reduced to equality with the aural. Another point of interest is the fact also brought out in all of the experiments of Miss Hamlin and in most of Drew's work, that the external conditions of the experiment determine strongly the direction of the subject's attention, and that any attempt at voluntary attention defeats itself and reduces the number of correct answers.

It yet remains to speak of the effect of a series of stimuli as compared with single pairs, and of the various rates of succession of the pairs in the series. Inspection of Table II shows that the tendency to perceive the flash first is the same in all the rhythmical series as in the single pairs, and therefore that the difference of result between Exner and Gonniesiat on one hand, and Miss Hamlin and her supporters on the other, cannot be due, as she suggests, to this difference in method. It will be seen, further, that at all speeds a series of stimuli decreases the least observable interval, and that with the exception of a single subject in a single test, this time decreases directly as the length of time between the pairs of stimuli increases.

The subjects all testified that at the rates designated as 'four,' and usually at 'three,' no effect of rhythm was perceptible. S. had only occasional feeble rhythmic effect at 'two.' In these forms, the experiment is obviously reduced to ten chances of diagnosing the same single pair. For this reason the slow rates were not given to all the subjects. Under these

¹ Beiträge zur Psychologie des Zeitsinns, *Phil. Studien*, IX, 291 ff.

² Attention: Experimental and Critical, *American Journal of Psychology*, VII, 1895-'96, 539 ff.

circumstances, too, the extremely low intervals perceptible are not surprising. The usual method was to make a decision on the first pair, and then see if the others confirmed it. In the two-second series rhythm was generally noticeable and helpful; the one-second rate was most agreeable and pleasant; the half second very lively; the four-second "deathly slow" and "nervous." It should be mentioned that at the fastest rate the apparatus did not always function perfectly, occasionally skipping a click or flash. Subjective control and introspective analysis of method seemed also quite difficult at this rate, and here S. reported that the clicks and flashes failed to combine, but formed independent series.

To recapitulate briefly, this study has shown:

1. That the flash-click order can be recognized when the interval is shorter than that required for the click-flash order.
2. That this holds true for a series of pairs of stimuli as well as for a single pair.
3. That the serial repetition of the pairs materially reduces the time interval necessary for right judgment.
4. The cause of this seems to be a retardation of the click due to greater attention-claiming quality attaching to the flash.

XIII. THE TIME REQUIRED FOR RECOGNITION.

By F. W. COLEGROVE.

The method employed in the following rough study was extremely simple. Sixty-eight pictures, three to four inches in length and two to three inches in height, were cut from an old magazine and pasted upon cards. These were inserted, one at a time, in the clips of the Cattell Fall-chronometer and exposed by the sudden falling of the screen. At the instant of exposure, the falling screen released one pendulum of an electrical vernier chronoscope, the other being released by the subject as soon as he was able to decide whether he had seen the picture before or not.¹ If the picture was recognized, the subject reacted with his right hand; if unrecognized, with his left. Five or six reactions to the letters R (right) and L (left) were taken before and after each sitting, and the discrimination times thus found furnish both a control of the other experiments and a means of finding the pure recognition time free of all peripheral processes.

¹ For the mode of operating the vernier chronoscope, see this *Journal*, Vol. IX, 191-7, Jan., 1898.

In the tables below, however, these simple discrimination times have not been deducted, but, on the contrary, the full time of response has been retained.

Five subjects were tested, all of whom had had some laboratory experience and two of whom had had a good deal. Five pictures, numbers 1, 2, 6, 44 and 68, were shown each subject before beginning and he became familiar with them. He also saw them again before each sitting. In what follows they are termed the "well-known pictures." On the first day of experimenting these were shown in irregular order with other pictures from the series. On the second day both the "well-known pictures" and the new ones of the first day could be drawn upon as known pictures to mix with a second group of unknown pictures; and on the third day the pictures of both the first and second days, and so on.

A considerable mass of records was thus obtained, both for the time required for recognizing the "well-known pictures," and for the time required for other pictures after one, two, three, four or more exhibitions. It is hardly necessary to mention that the first recognition, except in cases of mistaken reactions, occurs on the second exhibition and so on. The results for the earlier and later recognitions of the well-known pictures are given in Table I. In forming this table, the series of recog-

TABLE I.

Showing Times for Signaling the Recognition of the Well-known Pictures; Times in 0.001 Seconds.¹

Subject.	EARLIER RECOGNITIONS.			LATER RECOGNITIONS.		
	No. of Observat'ns.	Time of Recognition.	M. V.	No. of Observat'ns.	Time of Recognition.	M. V.
W	15	524	58	15	451	35
Y	22	490	119	27	432	38
S	17	615	65	19	516	55
K	23	571	124	26	474	68
Q	23	434	110	23	424	71
Average,	527			459		

¹ The times are given in the usual unit for convenience of the reader, though, as the unit of the chronoscope itself was 0.02, no significance is attached to the third figure of the results. It might be expected that with the method of division described in the text the number of

TABLE II.
Showing Times for Signaling Successive Recognitions of Pictures other than the Well-known Group.

	W			Y			S			K			Q		
	No. of Obs.	Time.	M. V.	No. of Obs.	Time.	M. V.	No. of Obs.	Time.	M. V.	No. of Obs.	Time.	M. V.	No. of Obs.	Time.	M. V.
1st rec.	19	705	111	33	550	100	15	644	129	26	625	124	25	490	95
2 "	15	597	82	26	516	99	15	667	101	28	634	139	14	533	98
3 "	6	527	47	13	522	75	6	550	73	17	606	114	4	465	83
4 "	2	530	50	3	587	142	1	540	60	12	515*	78	1	620	—
5 "	1	480	—	2	470	10	1	620	—	5	496	59	1	520	—
6 "	1	440	—	—	—	—	—	640	—	1	540	—	—	—	—
7 "	1	500	—	—	—	—	—	—	—	1	520	—	1	400	—
Average	45	622		77	533		40	633		90	600		46	502	

* One record, nearly 3 times as large as any other, was omitted from this average.

nitions for each picture was divided in the middle, if the number of recognitions was even, and the first part taken for the column of earlier recognitions, the second for that of later recognitions. If the number was odd and the full series could not be evenly divided, the middle term was discarded and the remaining parts treated as if the series had been even.

These figures show that the full time of signaling the recognition of a well-known picture lies somewhere between 424 to 615, and that it is shorter in the second half, where the familiarity was greater. This quickening may be due in part to increased skill in reacting. Two of the five subjects show a similar gain in reacting to the letters R and L, and with one subject, Q, the difference is more than that between the early and late trials in Table I, making the pure recognition times respectively 68 and 89. But it must be due chiefly to increasing familiarity with the pictures. Four of the five subjects show the same relation in the pure recognition times as in the table. The average pure times, found by subtracting 316 and 311 from 527 and 459 respectively, are 211 and 148.

The same thing is shown, though somewhat irregularly, when the successive recognitions of other pictures are examined, as in Table II.

How this increased speed of recognition should be regarded, whether as a hastening of the recognition process or as a gradual change in the character of that process from one which is more or less conscious toward one which is wholly automatic, or as involving both tendencies, is, unfortunately, not shown by the data at hand.

Beside this general question there are several of a subordinate interest, namely: Is there any difference in quickness of response when a picture is signaled as unrecognized? Is the quickness of response different when errors are made, *i. e.*, when a known picture is signaled as unknown, or *vice versa*? Is there any difference in the quickness with which different pictures are recognized? Such data as the experiments have furnished upon these points are gathered in the following paragraphs.

In Table III the time for the *first recognitions* has been taken from Table II, instead of the average time of all recognitions, as corresponding more nearly with the condition present when the pictures (before unknown) are signaled as unrecognized. It will be observed that three subjects (W, S and K) take longer to determine and signal a recognized picture than an unrecognized one; and two, Y and Q, take longer for the unrecog-

observations would be the same for the same subject in both early and later recognitions, and such would be the case except for differences introduced by failures in the functioning of the apparatus, and by erroneous reactions on the part of the subjects.

TABLE III.

Showing Comparative Quickness in Signaling Recognized and Un-recognized Pictures.

Sub- ject.	RECOGNIZED PICTURES.			UNRECOGNIZED PICTURES.		
	No. of Cases.	Time.	M. V.	No. of Cases.	Time.	M. V.
W	19	705	111	52	618	111
Y	33	550	100	40	583	88
S	15	644	129	48	587*	95
K	26	625	124	49	586	121
Q	25	490	95	43	564	99

*One record, nearly four times as large as that next it in size, was omitted in making this average.

TABLE IV.

Showing Comparative Quickness in Erroneous Reactions.

Sub- ject.	WRONGLY SIGNALLED AS KNOWN.			WRONGLY SIGNALLED AS UNKNOWN.		
	No. of Cases.	Time.	M. V.	No. of Cases.	Time.	M. V.
W	9	624	200	20	617	88
Y	19	536	118	27	586	116
S	6	550	137	15	635	98
K	10	614	128	31	570	105
Q	16	461	71	10	516	140

nized. This appears to be due to a difference in mental attitude, which will perhaps be clearer after a consideration of the results where errors were made. Y, Q and K show the same tendencies in Table IV as in Table III; the times of W when in error are practically the same without regard to the nature of the error; while for S the relation of Table III is reversed. The small number of cases and the large M. V. make it seem likely that this difference in the case of S is accidental, and examination of the separate determinations confirms that opinion.

The proportion of errors of each sort for the different subjects is, however, more characteristic than the times. The percentage of cases in which the error consisted in signaling as known a picture which had not really been seen before, is as follows: W 31, Y 41, S 29, K 24 and Q 62. W, S and K evidently tend less to false recognitions than Y and Q. Furthermore, if the records of the observers in all the tables be compared, it will be found in every case that subject Q made the quickest responses, and that in every case but one (*i. e.*, in wrongly signaling known pictures as unknown, Table IV, second half), Y stands next him in speed, while K, W, and S are always slower, though their order among themselves is different in different tables. Y and Q appear to err by being hasty.

The first inference, perhaps, would be that Q and Y belong to the motor type of reagents and carried their motor habit into these recognition experiments; and there was more or less in Q's manner of reacting to justify such an inference. Yet, if this were the case, something of the same tendency ought to appear in the records for signaling the presence of the letters R and L. The records, however, fail to show such a tendency; Q is slow as compared with the rest, and Y, though quick in the early part of the series, was excelled by both S and W in the latter part. It seems more probable, therefore, that Q and Y were somewhat on the lookout for known pictures, while the rest expected unknown pictures.

The grading of the pictures according to their difficulty of recognition was made on the basis of the errors recorded against them and checked by a subsequent calculation of the times required for certain special groups; all of the "well-known" pictures were excluded in this consideration.

Ten pictures had no errors at all or but a single failure in recognition recorded against them. They gave, together, thirty-three recognition times, with an average value of 568, and a M. V. of 111. Six pictures, on the other hand, failed of recognition on four or more occasions. These gave, together, nineteen recognition times, with an average value of 583 and a M. V. of 155.

Any statement of reasons for this slowness must be largely conjectural, but the pictures recognized with difficulty seem lacking in interest, either in the situation presented or because they involve a multitude of nearly co-ordinate details. The pictures that were most often recognized falsely (*i. e.*, signaled as known when shown for the first time), were a group of three drawings of country houses, all executed in a similar and somewhat peculiar manner, and not easily distinguishable in their general aspects, though offering no difficulty when placed side by side. Next these in suffering errors of this kind was a group of eleven

pictures, a number of which showed resemblance in subject or treatment to other pictures in the series. As was to have been expected from the nature of the experiment, the general effect is more important in both cases than details.

The general results of this study may be summed up as follows: The central processes of recognition in the case of ordinary magazine pictures take place in a fifth of a second or less, on the average, the time decreasing as the familiarity increases. Whether the judgment that a picture is known takes place more quickly than the judgment that it is unknown, seems to depend on the mental attitude of the subject—more quickly if he expects the exhibition of known pictures, less quickly if he expects the reverse. Differences in the facility of recognition are found with different pictures, depending chiefly, it would seem, upon their ability to arouse interest, or, in other words, to compel attention.

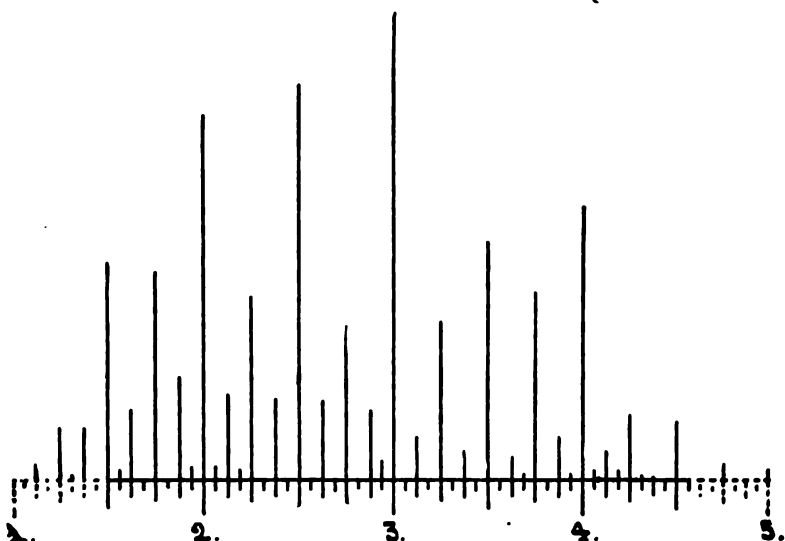
XIV. - NOTES ON MENTAL STANDARDS OF LENGTH.

By F. W. COLEGROVE.

The ability to make estimates of length presupposes some sort of mental standard which is applied to the length in question. The existence of such standards is very easy to demonstrate, and has even been found a serious obstacle in certain forms of psychophysical experimentation. Some effort has been made to find how accurately these mental standards coincide with the external units that they represent, but so far as the writer is aware no one has tried to investigate the nature of these scales and their mode of application. The present fragment unfortunately does not go far toward filling this gap, but may, at least, call attention to the matter as a subject for investigation. It would be interesting from the point of view of individual psychology if we could know, for a considerable number of persons, the nature and origin of their full equipment of mental standards—for weight, capacity, temperature, angular measure and money value, as well as for length.

The method of the present study was simple in the extreme, and the results can be briefly stated. Fifty circles, differing in diameter by sixteenths of an inch, and forming a continuous series from one and a half inches to four and nine-sixteenths inches, were drawn upon cards of convenient size. A similar set of straight lines of length equal to the diameters of the circles was also prepared, and was submitted with the circles to the subjects for estimation. The subjects were ten in num-

ber, including one who estimated the circles but not the lines. Six were university students (four were of the psychological department), and of the remaining four, one was the wife of a university student, one a carpenter, and one an expert machinist. The combined results of both series and for all subjects are exhibited in the following diagram. The short lines



projecting downward from the horizontal are intended to represent the objective scale, as ordinarily cut on measuring rules. The portions at the left of the one and a half inch mark and to the right of the four and nine-sixteenths inch mark are put in in broken lines to indicate that while not actually found on any of the cards presented, they were trespassed upon by estimates of the subjects. The longer lines erected upon the upper side of the horizontal are intended to indicate the relative frequency of estimates of the extent given by the division of the scale above which they stand. The estimate "three inches," for example, was recorded 110 times; that of "two and fifteen-sixteenths" (next line to the left) 4 times; that of "three and one-eighth" (next line to the right) 10 times. The detached line at the extreme right shows the relative frequency of estimates based upon other than the 2, 4, 8, 16, division of the inch; they were chiefly thirds, with occasional fifths and sixths; no other irregular fractions were given by the subjects.

It is easy to see from the diagram that estimates in sixteenths are infrequent. The eighth divisions are maintained throughout from one to four and a half inches. The quarters

are well marked, and the halves and whole inches best of all. The estimate "three inches," approximately the middle extent of the range used, was the most frequently given. In the eighths and quarters there is, as might be expected, a tendency to diminish in frequency from left to right, and this would doubtless have been much more marked had the range been more extended. Such a decrease in the fineness of the estimation scale with increase in its extent is easily verified in introspection, and is probably a case of the same sort of relativity that finds expression in Weber's Law, at least in its application to visual extents.

In a certain sense the diagram above may be said to represent the average mental scale from one and a half to four and a half inches, but it is in no sense to be taken as a picture of such a scale. The mental scale is probably a much more complex affair. It seems likely that most of us carry separate standards for the principal extents; 1, $1\frac{1}{2}$, 2, $2\frac{1}{2}$, 3 inches, and so on, and in estimating, classify first according to these. Then, if pressed for finer judgments, we estimate the excess or defect of the given extent in comparison with the nearest of these standards in such fractions of an inch as we have at command, and so arrive at a final estimate. The grouping of the sixteenths near the whole inches to be observed in the diagram, would accord well with such a process.

The subjects showed considerable individual differences in their fineness of estimate. Of the twenty-two estimates involving sixteenths, seventeen were given by the machinist, four by the lady and one by one of the psychologists.

Several subjects rarely estimated in eighths, and one used no eighths and only five quarters in fifty judgments. These differences are doubtless largely due to differences in practical familiarity with the measuring rule, but also perhaps in part to a difference in the seriousness with which the task was undertaken. The unusual fractions, thirds, fifths and sixths, were used to some extent by five subjects; with one exception, by those whose scale was not otherwise very finely divided. The use of these unusual divisions seems to indicate reliance upon a standard inch divided off-hand as occasion required.

The experiments, as arranged, were not adapted to test the objective truth of the estimates, but there seems to be a general tendency toward under-estimation. It was expected that this would be marked in the case of the circles, following the well-known illusion which affects circles when compared with squares of equal breadth, but the circles do not appear to have been more underestimated than the lines.

With a view of studying the ability of the subjects to estimate extents of less than an inch, the following variation of the

experiment was tried with eight of the previous subjects, the machinest not being included, however. A Brown & Sharpe micrometric gauge was set at the even tenths of an inch from 0.1 to the full inch and the subjects were asked to estimate the separation of the jaws. In this case all the subjects but one used divisions as fine as sixteenths, and one went as far as sixty-fourths. The remaining subject gave no fraction with larger denominator than six. One gave estimates in unusual fractions (thirds and fifths) but no one ventured on a decimal division.

Other tests were made in which the subjects drew their standards for the whole inches from one to five, and still others in which the lines were estimated from memory after a few minutes interval, but not in sufficient number to warrant presentation of the results.

NOTES ON THE CASTRATION OF IDIOT CHILDREN.

By EVERETT FLOOD, M. D., Supt. Hospital Cottages for Children,
Baldwinville, Mass.

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Dr. F. W. rt Boal read before the Illinois State Medical Society a paper under the title "Emasculation and Ovariectomy as a Penalty for Crime and the Reformation of Criminals."—*Jour. Am. Med. Association, Sept., 1895.*

Dr. A. Laphorn Smith, Montreal, Can., reports the case of Miss X., age 25, ovaries and tubes removed 7 years ago. Still has the same sexual feeling as before and indulges excessively.

Dr. E. J. Munroe, of Bordeaux, reports observations in two cases of ovariectomy in young women, which showed an effect on the voice exactly the opposite of what is brought about in the male by castration. The higher notes were lost and the voice fell from soprano to mezzo-soprano.—*Boston Med. and Surg. Jour.*

In a paper entitled "The Crimes of Medical Men," in the Medical Herald for June, 1896, Dr. W. O. Henry mentions as one crime the failure to urge legislation to prevent marriage of criminals or to have them castrated.—*Record, Sept., 1896.*

In the Annals of Surgery, Sept., 1896, Dr. A. T. Cabot discusses the question of "Castration for Enlarged Prostate," in which the writer takes, on the whole, an unfavorable view of the operation as compared with the older one of prostatectomy. Dr. White, one of the editors of the Annual, combats some of his conclusions. "The large proportion of cases mentioned by Dr. Cabot in which mental disturbance followed the operation is noteworthy, even if it is not directly attributable to the operation." A large mortality has followed the operation of castration in the aged for enlarged prostate.

Dr. Pilcher, Supt. of the Institute for Imbeciles and Weak Minded Children, at Winfield, Kan., has been bitterly denounced

by newspapers in Winfield and Topeka for castrating several boys, inmates, who were confirmed masturbators. His predecessor, Dr. Wile, had treated these boys five years without benefit, and Dr. Pilcher, taking a rational view of the subject, performed the operation for the same reason that he would perform any other surgical operation—for its curative effect. There is a strong probability that he will be indicted for mayhem, to the everlasting disgrace of the civilization of the nineteenth century.—*Texas Med. Jour.*

The House Committee on Public Health of the Kansas Legislature has made a favorable report on the bill which does away with the penitentiary sentence for men convicted of assaulting women, and substitutes castration. The Social Purity League of Topeka has been urging the passage of this bill, and the leaders of the league claim enough votes in both houses to pass it, and have secured the promise of Gov. Leedy's signature. They say that following the lead of Kansas, ten other states will pass the same law at their next session of legislature.—*Med. Record.*

"Castration in cases of sexual perversion and for habitual criminals has been revived in able papers read before the Chicago Medico-Legal Society, by Daniel, of Texas, and Way, of the Elmira Reformatory. The arguments advanced did not receive a very cordial endorsement from the members present, and the possibility of the adoption of the measure advocated is slight. It is too radical a change to be made in a hurry, and the fact must not be lost sight of that any such experimentation is contrary to the laws of nature and will receive almost universal condemnation."—*Cutting.*

A writer in the London Lancet gives us some information on the subject of the demand and supply of eunuchs in China. The emperor and certain members of the royal family are alone entitled to keep eunuchs. His majesty maintains at least 2,000, but no prince of the blood or imperial princess has a right to more than 30. In the production of Chinese eunuchs four chief factors prevail, viz.: greed, predilection, poverty and laziness. Many parents sell their male children to the mutilators, or themselves castrate them in the hope of eventually sharing their earnings. Both penis and scrotum are removed by a single sweep of the operator's knife or scissors. A small piece of wood or pewter is inserted into the open urethra and the wound washed with pepper and water. The patient is then walked for three hours without rest, and for the following three days he is allowed no drink, while the plug fills the urethra. On the fourth day the plug is removed and if the urine flows he is looked upon as cured; but, should the overstrained bladder refuse to act, he is left to die. Fatal cases amount to about three per cent.

number of other cases have been circumcised alone and all with good results.

Two of these cases had large varicocele which was all cut away at the time of castration.

The mental and moral condition was fair in 9, good in 2, and poor in the others; this has become better in 3 cases and remained unchanged in the rest; two were kleptomaniacs, and this manifestation has nearly disappeared since the operation; one was salacious, improved since operation; one was solitary, not so much so now; four were passionate and quarrelsome and are now much less so; one persistently eloped but now never attempts it; two were gluttonous and remain so; one was monkeyish and is still much the same; one was imbecile and is now more so; four ceased to have fits, though without much mental change, soon after the operation; the voice remains soft in five cases and is not perceptibly altered in the others. Masturbation has ceased in all the cases but one; that comes on at times only and lasts for a few days.

In one of the female cases, not included in the 26, masturbation is quite prominent at intervals, but at such times the girl is insane and demented. There has been gain in weight, aside from growth, in all cases but 3. The sexual appetite seems to be now missing in all the cases but 2, and in them appears only periodically. Erections sometimes occur but without erethism except in the instances where masturbation still occurs. No extra growth of legs or body has been noted in these cases, and could not well be, as they are nearly all still in the growing stage and have not as yet shown abnormal size. The temper has been improved in all instances but 4, where it remains unchanged. There is less pugnacity in all the cases, and less of anger, obstinacy and self-will. It seems that the cases grow more sympathetic and altruistic, and in some the emotional nature in general is better balanced and more nearly normal.

In all these cases the written consent of the parents has been obtained.

This class of work has been very little done anywhere, as public opinion has been much against it, and even among medical men no encouragement has been given until recently.

The effect upon the epileptic seizures appears to have been good in all cases. Some have ceased having the attacks altogether, though one has had an attack after two years of immunity, but it was brought on by over-eating. All the cases have the attacks less often and with less severity.

Only five of these cases have had bromide since the operation and they with diminishing doses, now reduced to five or ten grains once daily. All the others have been without medicine,

except that they have had tonics, such as Co. Tinct. Gentian, and cod liver oil, at intervals.

Fourteen of the cases are Americans, six Irish, one Scotch, one Swedish, the others being of unknown extraction. At present, 17 of the cases still reside in this Institution, 3 are in lunatic hospitals, five are at home with parents, and the whereabouts of one unknown.

ON THE WORDS FOR "FEAR" IN CERTAIN LANGUAGES. A STUDY IN LINGUISTIC PSYCHOLOGY.

By ALEX. F. CHAMBERLAIN, Ph. D., Clark University, Worcester, Mass.

In a previous essay¹ the writer discussed anger-words, and reference to this will be necessary since not a few fear-words are akin to those used to denote anger.

I. *Fear*, if we trust the etymology of its English name, is "an *experience*;" Skeat tells us that the word was "originally used of the *perils* and *experiences*; of a way-faring." The Anglo-Saxon *fæc* meant "a sudden peril, danger, panic, fear;" cognate are Icelandic *fár*, "bale, harm, mischief," Old High German *fdra, vár*, "treason, danger, fright," Modern German *Ge-fahr*, "danger, peril, risk." Related also are: Latin *periculum*, "peril, trial, danger" (from *perior*, the root of *peritus*, "experienced, skilled"), *experientia*, "experience, trial, proof;" Greek *πειρα*, "attempt, stratagem, trick," *πειράω* "I go through." The common radical of all these terms is the Indo-European root *Per*, "to pass through, to travel, to *fare* (as our own English word from the same stock has it)." In Old Norse *fár* has the additional signification of "plague, pestilence, misfortune," which may go to somewhat explain our expression "a plague of fear." *Fear*, then, emphasizes "what one has *passed* through."

II. "All of a *tremble*" is a popular description of the state of fear or terror, and not a few of our fear-words contain this primitive idea. We say "*trembling, shaking, quaking* with fear," and these expressions find their analogues in many other tongues. George Fox tells us in his "Journal" that "Justice Bennet [in 1650] was the first to call us Quakers, because I bade him quake and tremble at the word of the Lord," and all over the world the "fear of the Lord" has been largely associated with *quaking* and *trembling*.

The English word *terror* (French *terreur*, Latin *terror*), goes back to the same root which gave birth to Latin *terrere* (older form, *tersere*), "to dread, to be afraid," and, originally, "to tremble;" Russian *trasti* (*triasate*), "to shake, to shiver;" Lithuanian *trisžėti*, "to tremble;" Sanskrit *tras*, "to tremble, to be afraid," *trdsā*, "terror"—the radical of all being Indo-European *ters*, "to tremble, to be afraid." Of similar meaning, ultimately are *tremor* and cognate words derived from the Latin, and the derivatives of Greek *Tptw*, "I tremble, quake, fear, dread, am afraid of."

The German *Furcht* (the Middle High German *vorhte* signified "fear, anxiety, apprehension") is the abstract of the verb *fürchten*, cognate with Gothic *faurhtjan*, "to fear, to be afraid of," to which is related the adjective-participle *faurhts*, "fearful, timid," *faurhtlei*, "fear." The Teutonic radical *forh*, together, perhaps, with the roots of Latin *querquerus*, "shivering with cold," and Greek *χαρχαλω*, "I tremble," goes back to the Indo-European *perk* or *qerk*, "to tremble." Another word embodying the same idea is Gothic *reiro*, "tremble, terror"—*reiran*, "to tremble." To "tremble like an aspen" is

¹ *Amer. Jour. Psychol.*, Vol. VI, pp. 585-592.

a very ancient Indo-European figure of speech. The Latin *pavor*, "quaking, trembling, throbbing with desire, joy, fear," "anxiety, fear, dread,—the god of fear is personified as *Pavor*,—to be afraid, to fear, to tremble," and the Greek *Φόβος*, with all the *phobias* to which it has given rise in the various civilized languages, have at their base radicals which signify "to tremble." The corresponding verbs in Greek *Φοβέω* and *Φέβομαι* are related to Sanskrit *bhi*, "fear," *bibhēti*, "he is afraid," Lithuanian *bàimė*, "fear," *bijėtis*, "to be afraid," *bajūs*, "terrible," *baisė*, "terror," while the modern German *beben*, "to tremble, quake," goes back to the same Indo-European radical.

We speak in English of "shivering with terror, or fear," and it is interesting to note that in the "Gest Hystoriale of the Destruction of Troy," an English Romance circa 1390 A. D., we find "Achilles at the choice men *cheuert* (shivered) for anger."

The French word *craindre*, "to fear," belongs here also, being derived from the Latin *tremere*.

The radical meaning of English *shudder* is to "tremble."

III. Another closely related series of words is that in which the basal idea is *agitation, movement, stir*. Here belong the Latin *metus*, "agitation, anxiety, fear, dread, terror," *metuere*, "to fear, to be afraid of,"—allied perhaps to *mōtus*, "moved, affected, disturbed." *Trepidation*,—the Latin *trepidatio* signified "confused hurry, alarm, consternation, terror, trepidation,"—has a curious etymology. Festus, the ancient grammarian, glosses the old Latin *trepit* by *uerlit*, adding the remark "unde *trepidus* et *trepidatio*, quia turbatione mens uertitur." The Latin adjective *trepidus*, "trembling, alarmed, fearful, anxious," etc., would then seem to signify "in a state of disturbance, as if the mind is being continually *turned* about or agitated (Skeat)." The Old Latin *trepere* is cognate with Greek *Τρέφω*, "to turn," and also with Latin *torquere* (whence *torture*), the basis of all being the Indo-European radical *t-rk*, "to turn, to twist." So when we speak of being *tortured* by our fears we are but repeating a very old figure of speech. A coward we often say "*writhes* with fear."

IV. A common expression in English is "to *start* with fear," with which may be compared the colloquial "to almost *jump* out of one's boots;" we have also the derivative "to *startle*." The same idea is at the basis of the modern High German *Schreck*, "terror, fright, fear, horror," the Old High German verb *scrēckōn* signifying, "to start up, to leap, to hop," the Middle High German substantive *schric*, "a sudden start, terror," and the causative verb *schrecken*, "to cause to start, to make afraid." The radical is *skrik*, "to leap, to move suddenly, to start."

A cognate idea resides in the Modern German *sich entsetzen*, "to be startled at, to be terrified, to shudder," and the substantive *Entsetzen*, "terror, dread, horror, fright." The Middle High German *entsetzen* signified, "to cast down, to disconcert, to fear, to be afraid of." The Old High German *intsizzen* (there is also a M. H. G. from *entsitzen*), "to come out of one's seat, to lose one's composure, to fear, to be afraid of." In Gothic we find *andasēts*, "horrible," *andsilan*, "to be terrified." These words are all based upon the Indo-European root *sed*, "to sit," with a privative, or disjunctive prefix (Mod. German *ent*, Gothic *and*). The idea at the root of *Entsetzen*, is "starting from one's seat in terror."

V. The sinking of the heart and of the vital organs generally is a familiar conception of "fear" among primitive peoples, and one which appears very often in picture-writing and sign-language, as Col. Mallery has pointed out. Our own language furnishes cognate expressions, "to have one's heart in one's boots," "to feel one's

heart sink," etc. Being "down-hearted" is thus a very early form of fear.

Perhaps, here belong also the Yoruba (a West African language) *ai ya fò mi*, "I am afraid," literally, "the heart jumps me," *daiyafò*, "to frighten," etc., although the jumping is here the other way. We say, analogously, in English "my heart leaped into my mouth," in speaking of certain aspects of fear.

VI. The ghost in "Hamlet" describes several of the known symptoms of fear:

"I could a tale unfold, whose lightest word
Would harrow up thy soul, freeze thy young blood,
Make thy two eyes, like stars, start from their spheres,
Thy knotted and combined locks to part,
And each particular hair to stand on end,
Like quills upon the fretful porpentine."

The last mentioned symptom is illustrated by the etymology of the word *horror*. The Latin *horror*, "a standing on end, bristling, terror, dread," and *horre*, "to stand erect, to bristle, to be afraid, astonished, amazed, to startle with fear," etc., as the older form (*horre*) of the verb (cf. *hirsutus*, "rough, hairy, shaggy") shows, refer to the "bristling of the hair in fear." In Sanskrit *hirsh*, "to bristle," is said of the hair, "especially as a token of anger or pleasure" (Skeat).

Virgil refers to the bristling of the hair in the *Aen.*, II, 774:

Obstupui, steteruntque comæ, et vox faucibus hæsit.

VII. The "freezing of the blood" finds cognate expression in some of our fear-words, and besides we speak often enough of "the cold shivers" of fear, and "the cold sweat" that accompanies it. Our English *afraid* is the past participle of the verb *affray* "to frighten," which Skeat traces through the Old French *effraier* (*effraier*, *esfreër*), "to frighten," to a Low Latin *exfrigidare* (from *frigus*, "cold"), "to freeze with terror,"—in Latin *frigidus* meant "dead or stiffened with cold or fright," and Horace even uses it in the sense of "fearful." A common phrase in English is "numbed with fear."

VIII. Our English *dismay*, "to terrify, to discourage," comes, according to the Skeat, from Old French *dismayer* (cf. Spanish *desmayar*, "to dismay, to dishearten, to be discouraged, to lose heart"), which seems to have been supplanted very early by the verb *esmayer*, "to dismay, to terrify, to strike powerless"—the intransitive sense of which "to lose power, to faint, to be discouraged," would appear to be the older. *Desmayer* and *esmayer*, according to the best authorities, are derived from the Old High German *magan* (Mod. Germ. *mögen*, Mod. Engl. *may*), with the Latin prefixes *dis-*, *ex-*. The "loss of power" is the basal idea here. From Old French *esmayer* comes Modern French *émoi*, "fright, terror." Cognate also is the Italian *smagare*, "to lose courage." The English word *misgiving* has somewhat of the idea in *dismay*. With us, in English "to lose heart" is "to give way to fear."

IX. The Latin *consternatio* (whence our *consternation*), signified "consternation, fright, tumult;" the corresponding verb is *consternare*, "to stretch on the ground, to prostrate, to terrify, to alarm, to dismay"—the participle *consternatus* meaning "cast down, prostrate, frightened." The basal idea is seen in Latin *sternere*, "to throw down, to throw to the ground," from the Indo-European radical *st-r*, "to spread out." We employ a somewhat similar figure when we speak of "abject fear."

X. We often speak of persons being "rooted to the ground with

fear," "transfixed with fear," etc.; from fright people often stand "stock still." In Gothic we find *usgaisjan*, "to terrify," *usgeisnan*, "to be terrified," cognate with Old Norse *geiska-fullr*, "filled with terror," and Lithuanian *gaisztì*, "to swoon." Related also is the Latin *hære* (older form *hæsere*), "to cling to, to stick, to be unable to move away"—the radical of the whole series being Indo-European *ghais*, "to stick." We still say of a valiant man that "he will not *stick* at anything."

BOOK NOTES.

G. S. H.

Die Ideenassoziation des Kindes. VON TH. ZIEHEN. Berlin: Reuther und Reichard, 1898. pp. 66. Price, Mk. 1.50.

A scientific study of the association of ideas, Professor Ziehen notes with surprise, has scarcely yet been made; although from a theoretical, no less than a pedagogical, point of view, no field promises richer results. Galton has, it is true, done something with the associated ideas of adults, but in the domain of genetic psychology one finds only the most incidental references to the subject, and Professor Ziehen's study is an attempt to break new ground. His test was carried on with forty-two boys, from eight to fourteen, in the practice school connected with Rein's Pädagogische Seminar at the University of Jena. Certain monosyllabic words—the names of well-known objects—were at stated intervals pronounced to the boys and they were required to give the immediately suggested idea. The children usually answered in a word and these answers, or associated ideas, Professor Ziehen groups (1) rapid (springende) associations and (2) reasoning (urteils) association. "Rose—red" illustrates the first group. There is manifest absence of reasoning, and ideas of time and space are not taken into consideration. In the second group the child answers, "The rose is red." Here a definite rose is considered and time and space are indicated. The idea presented is also connected with the resulting idea.

Verbal associations constituted less than 2% of the associations made by the children, but Professor Ziehen concludes that such associations are more common among adults and most common in persons having mania or some form of mental debility. A form of association—somewhat related to verbal association—namely, word-completion, he found more general among the children, as, for example, postal—card; heart—shaped; post—office, etc. The most significant facts brought out in Professor Ziehen's study are (1) the universal application of the law of contiguity with the young child—only in verbal associations was there any hint of the working of the law of similarity, and the verbal associations, it will be recalled, were not numerous; and (2) the strong emotional element in the associated ideas of children. This, says Ziehen, explains why the memory-images of school excursions form so readily and are reinstated so easily.

WILL S. MONROE.

Studien und Versuche über die Erlernung der Orthographie. Von HERMAN SCHILLER. Berlin: Reuther und Reichard, 1898. pp. 63. Price, Mk. 1.50.

The spelling problem, notes Professor Schiller, in his introduction, is far from settled—German contemporary pedagogical thought to the contrary, notwithstanding. The results obtained in the schools, which are far from satisfactory, justify some investigation into the psychological basis of accurate spelling. The customary way of acquiring word-forms, assumes the author, is primarily through the eye and the ear. In order to have the accurate orthography of a word, the pupil must *hear, see, pronounce* and *write* the new word; and in order to

test the relative value of visual, auditory and motor methods in spelling instruction, Professor Schiller devised a series of words which were in eleven different ways propounded to classes of boys ranging in age from eight to nine. The following were the variations of the tests: 1. Words pronounced by teacher, the pupils holding their mouths firmly closed; 2. Words pronounced by teacher, the pupils repeating the same in a low tone; 3. Words pronounced by teacher, pupils repeating the same in a loud tone; 4. Words pronounced by teacher, and the pupils write the words in the air; 5. Teacher writes the words on the board, the pupils close the mouth firmly, and look at it an instant; 6. The same, the pupils pronounce the words in a low tone; 7. Same, the pupils pronounce the words in a loud tone; 8. Same, the pupils write the words in the air; 9. The teacher pronounces the words, the pupils spell the same, that is, name the letters and syllables in the words; 10. The same, the pupils pronouncing the words in low tones; 11. The same, the pupils pronouncing the words in loud tones.

Each test was repeated eight different times with words which had not been taught to the boys and which must have been more or less new to them. The efficiency of the different methods was judged by the errors made in subsequent efforts to correctly render the lists of words learned. It should be borne in mind that each list had eight repetitions; and, as to relative size and difficulty of words in the different lists, the balances were pretty approximate. The following comparison with regard to errors made suggests the efficiency of current methods of teaching spelling: Words written on board by teacher and copied by pupils, they pronouncing at the same time in low tones, 277 errors; the same, pronouncing in loud tones, 298 errors; words written on the board by teacher, and then written in the air by the pupils, 344 errors; words pronounced by the teacher and then orally spelled by the pupils, 356 errors; words written on the board by the teacher and then pronounced in loud tones by the pupils, 589 errors; the same, pronounced in low tones, 642 errors; the same, with the mouth firmly closed, 763 errors; words pronounced by the teacher and written in the air by the pupils, 772 errors; the words pronounced by the teacher and repeated in loud tones by pupils, 1,213 errors; the same, repeated in low tones, 1,801 errors; the same with closed mouth, 1,902 errors.

A study of the errors leads one to conclude (1) that merely hearing words pronounced is the least effective way of learning to spell; (2) that exposing the word-form to the eye reduces the number of errors; (3) that seeing the word-form and copying the same produces a minimum of error; (4) that writing in the air reduces the number of errors in both the seen and heard lists of words; and (5) that loud speaking—with one exception—proved more effective than low speaking. Professor Schiller made similar experiments in a Latin class, employing the same method, but substituting the Latin for the German words, and the results agree substantially with those already noted. He reaches three tentative conclusions from the study; (1) necessity of absolutely correct pronunciation of all words used by the teacher; (2) dictation should be less used and copying more generally employed during the early years of school life; (3) more time should be given to writing words in the air.

WILL S. MONROE.

Le rôle social de la Femme. Devoirs. Droits. Education par MME. ANNA LAMPÉRIÈRE. 1 vol. in 12 de la *Bibliothèque de Philosophie contemporaine*, 2 fr. 50 (Félix Alcan, éditeur).

This book does not pretend to be a complete study of the subject, but rather presents some general views which the author thinks should

be opposed to the partisans of 'la compagne féministe.' According to Mme. Lampérière, the function of woman in society should be absolutely different from that of man; she should be his co-laborer, not his competitor; she should be employed as organizer, not as producer; in a word, the social function, *i. e.*, duty, of woman, is to expend herself for society, for the race, as her domestic function is to expend herself for the family.

The identity of the rights of man and woman is rejected. The 'right' of the human being is merely the *right* to the full development of his faculties; but the faculties of woman are other than the faculties of man, though "of equal, if not superior, importance for the harmonious organization of the individual life and the social life."

The supreme right of woman is to be protected.

Starting from these ideas, Mme. Lampérière studies diverse situations of woman, notably *à l'atelier* and in marriage. She concludes by treating of the "education of this educator," which should be "conformable to biologic laws," and sets forth the object and the laws of the *Société d'études féminines*, created precisely with such education in view.

The Students' Life of Jesus, by GEORGE HALLEY GILBERT, Ph. D., D. D. The Macmillan Company, 1898. pp. 412.

This book aims to present succinctly and accurately the facts of the objective life of Jesus. No attempt is made to discuss in detail the teaching of Jesus; and the subjective side of his life is considered only as it is revealed in the Gospels. The book is in no sense interpretative. The author adheres pretty rigorously to his purpose of stating "the facts as directly and clearly as possible."

The Introduction, of about eighty pages, is devoted to establishing the historicity and authenticity of his sources, which are the Synoptic Gospels, the fourth Gospel, and the other New Testament writings, containing references to the subject. The author states the problem clearly in each case, and carries on the discussion with thorough candor; but his apologetic attitude leads him at times to lean rather strongly upon the argument from ignorance.

The rest of the book presents schematically the outline of the life, constructed from the aforesaid sources. The work is done critically, giving evidence of ample technical scholarship.

Though the author distinctly disavows any intention of adding any interest to the work not inherent in the facts, one cannot help feeling that the value of the book would have been enhanced by a slight infusion of warmth and color in the disposition of the facts.

W. S. S.

Biomechanik, von DR. ERNST MEHNERT. Privatdocent an der Universität Strassburg. Jena, 1898. pp. 177.

This is a philosophical discussion of the principles of organogenesis. Although the great biogenetic law that the individual recapitulates the stages of the development of the species to which it belongs is true in a large sense, the order in which it has developed does not follow their phyletic age, but is subject to much relative change. The heart, for instance, in the individual develops before the blood vessels, but this reverses the phylogenetic order. The walls of the large vessels develop before the blood corpuscles, while the converse was true in the development of the species. Ontogenetic age in all such cases is an index only of the intensity of kenogenetic energy. Retarded development of an organ on the other hand is an indication of regressivity, and Mehnert has collected much evidence of these cases, showing that abbreviation and retardation of different organs of a

creature, which is their bearer, are ontogenetic processes that are constantly operative. The latter may affect the date of the first appearance of an organ, the differentiation of its tissues among each other, or the entire processes of growth of a part or all of them. Organs are progressive according to the degree of their vitality. The rapidity of the growth of a part is directly as the degree of development acquired by the phyletic process. Each organ also has its own growth center more closely connected with and dependent on the organism of the series from which it has descended than it is upon those structurally or functionally near it or the organ of which it is a part. In other words of all its determinants, those that are inherited are the most important. This is especially true of periods of sudden, explosive growth functions, the interconnection of organs and relation to the environment, and all other individual or epigenetic factors are real and important, but subordinate determinants, so that embryological growth is purest.

It may be further assumed that ripe determinants and a directive programme of energy develop more than those that are immature. The eozyoon or paleoatavistic bases of heredity are the formative principles of fundamental organs. These bases condition all others and are constant. The neoatavistic factors on the other hand are the intensity and rapidity of development due to later and more individual influences upon heredity. The earlier part of the life of an animal is more established and more conformable to Weismannism, while the latter part of each individual life is more characterized by the evolution of acquired qualities. Lower animal, especially aquatic forms, that have been subjected to unfavorable conditions, produce young before they are mature or full grown; and these young then tend to stop in their own development at the stage where their parents were when they were produced. Growth might almost be defined as getting loaded up with inherited qualities. Although even epigenetic cells developed under the influence of function may be short lived, still assuming the monophyletic origin of animal life, and also assuming that maturity and death are longer delayed as we ascend the scale of being, more and more weight must be assigned to the later acquired than to the earlier and more stable qualities.

Basal and lapidary as is the biogenetic law, the work of Appel, Keibel, Mehnert, and many others have demonstrated that the exceptions to it are numerous and important. Each higher animal is composed of organs phyletically old and new, and the order of their development may be greatly changed. So great is this "heterochrony" that it may be said in general that the time at which an organ appears is dependent upon the time when it is needed for use, and organs decay as their functions cease. Every animal is, therefore, a mixture of high and low qualities. In many respects many of the lower animals excel man. The generalization here important is that by youthful parents heredity is more confined to older and lower qualities, so that those who attain sexual maturity early do not advance the phyletic series. Species and individuals on the other hand that attain propogative power late make for progress of the stock, because they had not only the wealth of heredity in its completeness, but contribute individual additions, infinitesimal though they may be. Early marriages, therefore, tend to the decay of culture and civilization, and all conditions that make for its "neotenia" are retrogressive, and each generation must reacquire everything anew because parents transmit nothing not transmitted to them. Conversely, if we follow Mehnert, hyperheredity due to long delay of propogation may be a factor for accounting for the overgrowth of the horns of certain

stags, some of the monsters of the geologic past, and other hypertrophied organs of individual species and functions, even those of genius.

Die Psychosen des Pubertätsalters, von WALTER WILLE. Leipzig u. Wien, 1898. pp. 218.

We have here a careful description of 135 cases of psychic diseases during pubescence, which the author places between 14 and 23, which he has observed during the last fifteen years at the Insane Asylum of Basle. He concludes that there is no specific pubertal insanity, but that puberty gives a peculiar character to their psychoses, all of which may occur at this age. Atypic and mixed phases are unusually frequent. The most common hebephrenic traits are frequent and causeless changes of moods, a certain superficiality that prompts stupid jests in the midst of lamentations; expressions of world pain during the jolliest hours; sudden changes of thought form with the most bizarre construction of sentences; extravagance, talkativeness, echolalia; impulsiveness in action; a theatrical reference to spectators and other degenerative traits play the leading role here. Contradictions are frequent, and delusions of greatness and a sense of exaltation alternate with the most depressive unworthiness. Moreau specifies sudden changes from sadness to gaiety; spells of unusual activity; extreme confidence often combined with chorea and catalepsy. Regis thinks pubertal insanity, more often moral, shows itself in morbid acts and impulses rather than in the intellectual sphere. Savage says psychic abnormalities are like those of early childhood, only more expressed, and that all its many phases tend to issue in weakmindedness. At no time is dysmenorrhea so liable to intellectual disturbance. Blanford thinks violence more common than delusion and that St. Vitus Dance is characteristic. Trowbridge distinguishes between short duration and true psychoses, the latter being usually incurable. In all, periodicity with lucid intervals is common. Moral perversions of boys are prone to take the form of cruelty or crime, while girls are more liable to shameless and erotic perversity; while egotism and self satisfaction are common to both sexes.

Névroses et Idées Fixes, par PROF. F. RAYMOND et DR. PIERRE JANET. F. Alcan, Paris, 1898. Vol. I, pp. 492; Vol. II, pp. 559.

The first of these two heavy volumes, with sixty-eight cuts, is devoted to experimental studies on disturbances of will, attention, memory, emotion and fixed ideas; and the second, with ninety-seven cuts, describes clinical cases and gives suggestions as to treatment. The copious analytical index at the end permits ready reference to all the rich material. Few will perhaps agree with the somewhat extreme standpoint of the author, which describes so many and varied affectations as traceable directly and indirectly to fixed ideas, but it must be admitted that the cases tend to favor the views of the close association between mental and nervous disturbances. The strong point of the work is the interpretation of individual cases. The writer is fully alive to the partial truths that may be contained in the current notions of mental healing. Such topics as confusion, aboulia, emotive delirium, impulsive obsession, somnambulism, chorea, tics, visceral spasms, contractures, allochiria, subconscious hallucinations, hysterical hemianopsia, insomnia, due to fixed ideas and possession, are illustrated, and explanations of very suggestive, if not always conclusive, character, are given.

The Passing of Plato, by O. P. JENKINS. Stanford University Press, 1897. pp. 23.

Here is a Professor of Physiology in the Leland Stanford, Jr., Uni-

versity, who notes the fact that the Greeks originally were sympathetic lovers of nature, till Socrates and Plato, who, "with the purest and best of motives, unconsciously did the race a disservice that became a bar to progress for the ages to follow." The mind can make any hypothesis so there was no trouble to attain any required definitions, "and to defend the whole of these it was necessary to do away with the rest of the universe." These "innocent diversions of Plato," were followed by Aristotle, to whom "mental flights were more attractive than his studies of bugs and fishes." Then follow many other systems evolved from the "lazy philosophy of Plato," but pure thinking, which spread over the world like cobwebs over the lawn on a summer's day, all inspired by Plato. Despite many hopeful signs, these conceptions and methods hang like the old man of the sea upon the neck of the present. Now science is changing all this.

Any well trained student in the history of philosophy will recognize the partial truth of the above, and if he has read Lange's Positivism vs. Idealism, he may detect a similar spirit here, but the author's extreme onesidedness; the surprising lack of historical perspective; his failure to recognize one of the axioms of evolution as applied to man; to say nothing of the fact that Plato was never so much studied as to-day, and that by men as much in sympathy with physiological and biological sciences as himself, altogether make this a very strange note to be sounding at a university commencement.

Moderne Nervosität und ihre Vererbung, von CH. FÉRÉ. Berlin, 1898. pp. 284.

The influence of heredity upon the origin of mental and nervous diseases are—this assumes that there is no nervous disease not connected with anatomical change, and the author undertakes to apply the general laws of biology in this field to pathology. Many diseases and malformations are considered, and even epilepsy and hysteria, it is assumed, must have a physical and transmissible basis. To establish his thesis, the author at the outset makes very material qualifications of the extreme views of Weismann and his followers; lays considerable stress upon the mutability of nervous diseases, especially these transmitted from one generation to the next; and undertakes in some respects to suggest morbid equivalents. He believes that all degenerative tendencies can be successfully combated, provided there is a fit hygiene of propagation which consists mainly in systematic rest beforehand and the most favorable nutritive conditions. The author's repertory of casualistic material is large, and twenty interesting cuts of inherited abnormalities and deformities are given.

Archives of Neurology and Psychopathology. Vol. I, Nos. 1 and 2. 1898.

This new archive is most sumptuously bound and printed, and is to be published in four annual numbers per volume, price, \$3 a year. It is to be published under the auspices of the New York State Hospital and the Pathological Institute, by permission of the State Commission in Lunacy. It is to be edited for the former by Drs. G. A. Blumer, C. W. Pilgrim and S. H. Talcott; and for the latter by Drs. Ira van Gieson, Boris Sidis and H. B. Deady. The longest and most important article in the present number is entitled, "The Correlation of Sciences in the Investigation of Nervous and Mental Diseases," by Ira van Gieson, which occupies about 235 pages. A briefer preliminary communication by Van Gieson and Sidis on "Neuron Energy and its Psychomotor Manifestations," makes up the entire number. The archives will contain studies on abnormal mental life and their neural concomitants based on psychology, psychopathology, experimental

physiology and pathology, cellular biology, pathological anatomy, comparative neurology, physiological chemistry, anthropology and bacteriology.

Annual and Analytical Encyclopædia of Practical Medicine, by CHARLES E. DE M. SAJOUS, M. D., and 100 associates assisted by corresponding editors, collaborators, and correspondence. Illustrated by chromolithographs, engravings and maps. F. A. Davis Co., Philadelphia, New York and Chicago, 1899. Vol. II, pp. 607.

The two volumes already issued come down to and include diphtheria. Most of the sections in the entire work are prepared under the immediate supervision of the editor, and are submitted to members of the assistant staff for revision and correction. Each author can change, erase and add. This second volume inaugurates the plan of work as regards elaboration. Some of the best articles in the present volume of interest to psychologists are on deaf-mutism, catalepsy and cocaineomania.

The volumes thus far published are of very attractive appearance, printed in large clear type on two column pages, and tastefully and conveniently bound, and what is perhaps best of all in most cases bring down the literature of the more important subjects to the present year. Such a work was greatly needed in practical medicine, and the high character of the authors, as well as the work which has thus far appeared, is sufficient to stamp the encyclopædia as an honor to American scholarship, a necessity for practical physicians and a convenience, not to say a luxury, for psychologists.

Foot-notes to Evolution, Series of Popular Addresses on the Evolution of Life, by DAVID STARR JORDAN, Ph. D., President Leland Stanford, Jr., University, with supplementary addresses by Professors E. G. Conklin, F. M. MacFarland, J. P. Smith. Appleton and Co., N. Y., 1898. pp. 392.

These papers on organic evolution were originally given as oral lectures before University Extension Societies in California, and some have already appeared in the *Arena* and *Popular Science Monthly*. It is not intended as a text-book on evolution, although most of its phases are touched on, partly because the different topics are very unequally treated. President Jordan's papers are entitled—the kinship of life; evolution, what it is and what it is not; the elements of organic evolution; the heredity of Richard Roe; distribution of species; latitude and vertebræ; the evolution of mind; degeneration; heredity insufficiency; the woman of evolution and the woman of pessimism; the stability of truth; the struggle of realities. There are twenty-eight illustrations and five full page plates. The topics are treated in a very lucid and popular way, and the book marks an important addition to the illustrations and demonstrations of the development theory.

The Gospel According to Darwin, by WOODS HUTCHINSON. Chicago, 1898. pp. 241.

This book is an effort to glance at some of the influences affecting human hope and happiness from the evolutionary standpoint, and to show how this attitude has a broad and a secure basis for courage and happiness in the present and for hope in the future that the message of Darwin is really the gospel of good, and that the natural is as wonderful as the supernatural, so that we need not longer limit our worship to the mysterious. Darwinism, as the author conceives it, has a wonderful power to broaden and deepen religious interest in the spirit of worship. The chapters are entitled—the fifth gospel, the

omnipotence of good, the holiness of instinct, the beauty of death, life eternal, love as a factor in evolution, courage the first virtue, strength of beauty, the benefits of over population, the duty and glory of reproduction and the economics of prostitution, the value of pain, lebenslust. The author is eloquent and poetic, and in many respects suggests Drummond, but has less sympathy with conservatism.

Les Pensées de Tolstoï, d'après les Textes Russes, par OSSIF-LOURIÈ. F. Alcan, Paris, 1898. pp. 179.

In this little book with a preface dedicated to Ribot, the writer selects pregnant quotations from Tolstoï, and groups them under the heads of life, man, society, religion, power, patriotism, militarism, riches, work, happiness, science, art, education, feminism, love, marriage, the good, evil, truth, the ideal, and death. A complete list of Tolstoï's works are appended, and also a list of works in different countries that have been influenced by Tolstoï. Each quotation is numbered for cross reference to sources.

La Philosophie de Charles Secrétan, par F. PILLON. F. Alcan, Paris, 1898. pp. 197.

Secrétan is known as the philosopher of liberty, from the title of his chief work which treats of liberty, human and divine, in a special connection with the three great Christian dogmas of creation, fall and redemption. Liberty and the philosophy of Christianity are for him synonymous terms. The material of the books falls into the three natural chapters of metaphysics, morals and critical observations.

Dynamic Idealism, by A. H. LLOYD, Ph. D. Chicago, 1898. pp. 248.

This is an elementary course in metaphysics of psychology first entered upon in lectures before the students in the University of Michigan. Psychology without metaphysics is useless if not absurd, and real psychology is metaphysics. The author has been more interested in the relation of the psychological theory to dualism or monoism than to any of its mere external details. Only metaphysical principles can make any process really complete. The first duty of psychology is to give the distinct doctrine of the soul. The organs of the soul are after all the true definition of it. The author discusses in the first part, the world and things including change, organism, body, outer world; secondly, ideas not as forms but as forces; consciousness as interest, etc.; and thirdly the world of acts, the will, the living ideal. The appendix contains a study of immortality in outline.

A Treatise on Aphasia and other Speech Defects, by H. CHARLTON BASTIAN. London, 1898. pp. 366.

Five of the seventeen chapters of this work are reproductions with a few additions from the author's Lumleian lectures, and treats the subject in a more complete way than has hitherto been attempted. Theoretical opinions are in general avoided and very many typical cases, some of which are from the author's own observation, are presented, especially where the necropsy was carefully made. Speculative classifications are to a great extent omitted, and some attempt is made to simplify the nomenclature. The relation between thought and language, classification of speech defects and those of writing, due to structural or functional degradation, amnesia, etiology, and modes of recovery, amimia, prognosis and treatment are perhaps the studies most fully treated. This work in general, comprehensive as it is, well illustrates the fact that we really know far more about sensory than we do about motor aphasia, and quickens the hope that the long promised and long delayed work of Dejerine will soon appear.

Histoire de la Sépulture et des Funérailles dans l'Ancienne Egypte, par E. AMÉLINEAU. Paris, 1896. (Annales du Musée Guimet) pp. 336 and 345.

These volumes, the twenty-eighth and twenty-ninth of the Museum, consist of the history of sepulture and funeral rites in ancient Egypt, and are illustrated by 112 wood cuts. The profound influence of the form of Egyptian belief in immortality dominated art, architecture, etc., and no country is fuller of monuments of this belief than Egypt. The monuments, tombs, etc., are described historically, and with great detail; although all the chapters are exceedingly objective, the author does not hesitate to pause for interpretations sufficient to define his standpoint for the reader.

Affirmations, by HAVELOCK ELLIS. London, 1898. pp. 248.

"How happy the world might be if there was no literature but the Bible, if Augustine, Aquinas, Calvin, and thousands of smaller men, had not danced upon it so long, stamping every page into mire." The author has been all his life casting away knowledge gained from books and literature and coming toward that haven of knowledge where a child is king. Very different from this is the literature of life, and the author uses Nietzsche, Casanova, Zola, Huysmann, and St. Francis, essays on whom make up the book, as stalking horses to creep up more closely to the life his soul loves so well. He has a special predilection for questionable themes and deems it useless to discuss others, although certainty is the end of all. He desires to settle a few things, clean out the Augean stables, and recall the simple, eternal facts of existence. Yet for every man his own affirmations are always the best. The essays are written in a sprightly style, and while they presuppose some things about the author treated, make the best of all introductions to them.

The Problems of Philosophy, by JOHN G. HIBBEN, Ph. D., Stuart Professor of Logic, Princeton University. New York, 1898. pp. 203.

As an introduction to the study of philosophy, the author's design is to indicate between points at issue on controverted questions without details or exhaustive criticism. It is assumed that the student who is beginning the history of philosophy will find himself at a loss to understand the relation between earlier and later periods, and will lack proper perspective to appreciate the drift of opinions. After the plea for philosophy, the successive chapters discuss the problem of ontology, cosmology, psychology, epistemology, logic, ethics, political science and æsthetics. The standpoint is that of idealism, the method lucid, and the book attractively printed and bound, and conveniently indexed.

The Skin Considered as an Organ of Sensation, by J. S. LEMON, Ph. D. Gardner, Mass., 1899. pp. 56.

Dr. Lemon, a former pupil of Clark, here treats the genesis of touch and of the skin and nervous system; the resumés of different theories about these topics and central localization; analyses of different skin senses and the recent experimental investigation upon them; discusses illusions, etc. The strong point of the paper is perhaps the author's study of the earlier history and literature of the subject. From one to half a dozen writings by 128 authors are appended.

The Doctrine of Energy. The Theory of Reality. By B. L. L. London, 1898. pp. 108.

The author has previously published essays entitled, "Matter and Energy," and "Are There Two Real Things in the Physical Universe?"

His theory was that the present conception of energy supersedes the idea of matter and by itself explains all the real elements in all physical phenomena. This view is now presented from the metaphysical standpoint. What we call volition in all its forms is dependent upon the unseen energetic substratum "whose transmutations to volition merely initiates and works, and it is natural to suppose that all the motions and transmutations of this energy are similarly originated by the supreme intelligence or will." Intelligence and this unseen basis on which all its actions are exerted and out of which its perceptions are derived, are the two real entities which reason must predicate. Sense phenomena result from their interaction and are a mere quality of that phenomenal world which contains neither of the real entities.

Der Körper des Menschen, von DR. A. BRASS. Wernigerode a. H. 1898.

This is the first installment of the first of three volumes, entitled development history, which is to contain an atlas with many illustrations in color. All is to be written in a way to represent the present state of science and to be easily intelligible by all. This first section of sixty-two pages, four of which are devoted to wood cuts and three to colored engravings, treats of sex and reproduction. Technical terms are avoided when possible, and when not, they are very briefly explained, and the style is certainly very simple, and many facts are stated as though written from a large fund of information.

Guesses at the Riddle of Existence and other Essays on Kindred Subjects, by GOLDWIN SMITH. The Macmillan Co., New York, 1898. pp. 244.

Three of these five papers have appeared in the North American Review or Forum, and all are written according to the view that amidst all the religious doubts and perplexities of the present are that our salvation can only be found in uncompromising allegiance to the truth. The spirit is not agnosticism but hopeful inquiry; despite the collapse of proofs of a supreme being, our hearts affirm him. The church and the Old Testament; the miraculous element in Christianity; morality and theism are some of the other topics treated.

Spiritual Consciousness, by FRANK H. SPRAGUE. Wollaston, Mass., 1898. pp. 238.

Men have been fed on the dry husks of materialism until they cry out for something better. Spiritualism, Christian Science, spiritual healing, theosophy mark an earnest desire to reach the inmost kernel of life. This and the tendency of the age toward unity are everywhere noted, and in a few points are sought. These tendencies are discussed in chapters entitled: what is truth; realization of ideals through right thinking; the outer and inner world; consciousness; Christianity; growth of society; the problem of evil; spiritual basis of love; manifestations of the spiritual principle; music, art and nature. There is almost no reference to literature, and the earnestness and seriousness of the author are impressed on every page.

Destinée de l'Homme, par M. l'ABBÉ C. PIAT. Paris, 1898. pp. 244.

The primary certainties in the world are psychological, that is, spiritual, and their quality and intensity are fundamental. The unknowable is especially found in our passions. Eternity of the ideas does not imply that of human thought, and we cannot reason from their nature to the quality of the soul. Our theory of impersonal reasons cannot be proven. Liberty cannot solve the problems of the unconscious limits and bases of our mental being. Thought and nerve action

are a mysterious solidarity. The fundamental beliefs of the world are: purpose, thought, love, action. Materialism has no possible proof, spiritualism rests on the solid basis of teleology and must grow with time.

Ueber die sexuellen Ursachen der Neurosthenie und Angstneurose, von DR. FELIX GATTEL. Berlin, 1898. pp. 68.

The author has collected and tabulated 100 cases from which he draws the conclusion that the neuroses of anxiety always tend to occur wherever there is excessive retention of libido; while pure neurasthenia occurs only as a result of masturbation. In none of the 100 cases he collects was the sexual life normal.

Gerichtliche Psychopathologie, von DR. ANTON DELBRÜCK. Leipzig, 1897. pp. 224.

The author is a specialist in the Insane Asylum of Burgholzli and privatdocent at Zurich, a pupil of Forel, and addresses his brief textbook to students, physicians and jurists. After discussing the nature or legal responsibility, methods of investigation and the qualifications of experts, the writer takes up the leading types of mental diseases, including poisoning, neuroses, including epilepsy, hysteria, constitutional disturbances and arrested development. Perhaps the topics best treated are: imperative ideas, moral insanity, morbid impulses, simulation. The clinical material occupies but very little space; a digest of laws and a copious index are appended.

Problèmes d'Esthétique et de Morale, par C. R. C. HERCKENRATH. F. Alcan, Paris, 1898. pp. 163.

The writer is a professor in a Holland Lycée, and presents briefly his views on beauty, sublimity, tragedy, comedy, laughter, morality and its evolution, the moral sentiments and the relations of æsthetics and social science.

Christentum's Ende, by FRIEDRICH NONNEMANN. Munden, 1898. pp. 145.

Lest the startling title of this book should give alarm, it may be said at the outset that it is introduced by a dream, and is written novel-wise and most ecstatically. Christianity ends in Jesus Christ, to whom be thanks, praise and love forever.

Die Entwicklung der Religiosität und das Werk der Religion, von DR. E. REICH. Zweiter Band.

Das Werk der Religion und der Kampf gegen das Verhängniss. 1898. Zurich. pp. 426.

The author here writes in his characteristic prolix but entertaining style with voluminous and apt quotations on the categories and essence of time and eternity; the practice of religion by means of hygiene and education; morals and culture. The agents by which the warfare is waged against fate are: society, humor, temperament, energy, feeling, character, genius, religion; and fate is found in false societies of social organization, politics, insanity, alcoholism, nervousness, gambling, other forms of evil and sin, and degeneration generally. The book should be regarded, not as a treatise that adds essentially to its topic, but as an interesting and stimulating collection of opinions with sensible and interesting comments from many fields, especially that of anthropology, in which the author's learning is so extensive.

The Book of the Master, by W. MARSHAM ADAMS. Putnam Sons, New York. pp. 204.

The author describes the Egyptian gospel of the light born of a virgin

mother. It traces a clue afforded by the comparison of the secret passages and chambers in the great pyramid with those described in the second papyrus, familiarly known as the "Book of the Dead," but originally entitled "The Book of the Master of the Secret House." Both reproduce the same religion, one in stone, the other in words. He finds no symbolism in either, but undertakes to express in clear form, where all may follow, an outline of the deeply veiled doctrines of the earliest recorded religions, which certainly, as he interprets it, was full of majesty and beauty. He describes the prevalent ideas of the resurrection in Egypt; the religion and light; the festivals of the sun and moon; the temples of the virgin mothers; the entrance of light and instruction; the initiation of the postulant; the illumination in truth; the master of the secret. The book contains some thirty illustrations.

Les Croyances de Demain, par LUCIEN ARRÉAT. F. Alcan, Paris, 1898. pp. 178.

Despite its ambitious title, the pretensions of this booklet are modest. The author does not attempt to define the faith of the future, but only to hint at a few of its features. At best the system of philosophy is only a pocket mirror to see nature in; but our author wishes to be naïve and ignore all philosophies. His standpoint is that of the parliament of religions at the Chicago Exposition. His view is, on the whole, optimistic. The certitudes which make the first part of his book are that religion will enlarge its horizon, extend its sphere of activity, but his sentiment will always guide man. Justice is written in the very mechanics of nature, and moral evolution is certain; and so is both the individual and historic sanction. The second part, or conjectures, discusses the cosmos, the soul, God, science and education. Religions will be less exclusive; their harmony will be more emphasized and their differences less; nature will be seen to be neither cruel nor beneficent; and the highest human service consists in turning its energy toward the improvement of the social life. The doctrine of personal immortality will grow dim; that of a personal God may be superseded by the definition of the ideal sum of phenomena; philosophy will take the place to some extent of theological dogmas; international barriers will be broken down; risks minimized; the feeble eliminated; and peace will reign. Life is what we make it, and especially what we wish to make it. We must, therefore, believe in the good and have energy to bring it to pass.

État Actuel de la Question de l'Acœboïsme Nerveux, par RENÉ DEYBER. Paris, 1898. pp. 127.

The conclusions of this doctor's thesis are that protoplasmic movement plays an important part in cell action generally, and that nerve cells differ from others in having peculiar means of prolongation and retraction, suggested by their very structure. Visual cells of the retina and motor functions although their plasticity may be less than those of the pyramidal cells in the brain. This amœboidism or dendritic prolongation of neurons exhibit almost every possible transition from temporary pseudopodia to vibratory hairs. In those organs where the existence of centrifugal fibres is demonstrated, central cells command movements of cells of less importance, and chromoblasts. These may be called in a sense veritable nervi-nervorum.

History of the Principle of Sufficient Reason, by WILBUR URBAN, Ph. D., Reader in Philosophy, Princeton University. Thesis, February, 1898. pp. 88.

After stating the problem, the author characterizes pre-Leibnitzian

thinking, and then the philosophical motives of Leibnitz; Kant's idea of sufficient reason as the basal principle of metaphysics; the struggle between Trendelenburg's logic and Herbart's metaphysical motives; and describes the Sigwart and Wundt view of sufficient reason as the base of logic.

Psychologie der Veränderungsauffassung, von L. WM. STERN. Breslau, 1898. pp. 264.

The author is a privät-docent in the University of Breslau, and attempts to answer the question, how change can be known, or what are the psychic roots of this category, and what are its various modes of operation in the field of the different senses? The best part of the work is the second, which gives an excellent presentation of the technique and methods of experimental determinations of minimal changes to show the psychic excitability for them and to develop their laws. Incidentally the effects of signals, fatigue, surprise and expectation, optimal time, etc., are discussed, and on the whole the topic is treated in a way so stimulating and suggestive that the author's conclusions will, we think, generally commend themselves to experimenters.

Essai d'une Philosophie Nouvelle, par LÉONCE RIBERT. F. Alcan, Paris, 1898. pp. 562.

The plan and purpose of this volume is unique; although the author only claims the virtues of the diligent compiler and popularizer, he undertakes to present the general conclusions of cosmogony and the nebular theory, celestial mechanics, geology, laws of heat, chemical affinity, light, electricity, paleontology, animal life, savage and barbarous man, and to draw the general results of Greece, Rome, the Middle Ages, to criticise current systems, and to draw from it all metaphysical and moral conclusions. He believes the idealism of the future will rest on the solid basis of fact, and the new philosophy owes its origin for him to new conclusions of the special sciences about nature. It is thoroughly ideal and metaphysical, but not positivistic.

L'Etre Subconscient, par Dr. E. GYEL. F. Alcan, Paris, 1899. pp. 191.

Dr. Gyel at first describes obscure facts in normal and abnormal psychology. The latter, treated at considerable length, involves hypnotism, telepathy and psycho neuroses generally, with attempts to explain all the established phenomena. The three laws that he draws from it all are the evolutive laws of progress, effort and solidarity, and thus reaches a new explanation of evil, of morals and the social question. He believes thus he can reach the philosophy of the future based on positivistic knowledge and guided by deductions in strict conformity with the scientific spirit.

Jahresbericht über die Leistungen und Fortschritte auf dem Gebiet der Neurologie und Psychologie. I. JAHRGANG. Karger, Berlin, 1898.

This large volume of 1,508 pages in the first resumes the best of its over 3,500 papers on nervous and mental diseases that appeared during the year 1897. Professors Flatau, Jacobson and Mendel, all of Berlin, are the chief editors. Fifty-three names, many of them prominent, are named as collaborators. The range of topics is wide, including therapeutics and criminal anthropology. Besides a general index, outlining its plan of arrangement, there are two full indexes, one of topics and the other of authors' names, at the end. The difficulties of such an undertaking, especially for the first year, are immense, and nothing but German industry could cope with them. All psycholo-

gists, as well as neurologists and alienists, will most heartily welcome this as a boon of the highest practical value for their work. In few topics is its really valuable literature more widely scattered in many languages and in publications of more various kinds. As far as we have examined this great work, we find nothing in it not worthy of hearty commendation, and all interested will share our earnest hope that the yearbook will meet the encouragement it so well merits and be continued.

With Pillon's *Année Philosophique* now in its ninth year; the *Année Psychologique* of Binet and Henri; the *Année Biologique* of Delage, the student of psychology, in the large sense of that word, has aids to his work that are not only valuable, but indispensable.

L'Education des Sentiments, par F. THOMAS. Paris, 1899. pp. 287.

Intellectualism has been the ideal of education, but in the present reaction against its ideals there is a tendency to study and train the sentiments. Pleasure is a guide and aid, and pain makes pleasure more intense and puts us on our guard against many evils. Neurasthenia, which increases pain, is combated by change of work, rest, exercise, country life, rules of hygiene. Fear is educable by judicious exposure to it, anger by restraint, curiosity by rational gratification, etc. The instinct of property, self-esteem, social inclination, friendship, patriotism, sympathy, pity, love of truth, of play, the beautiful and good, are all educable by various means. The book is very interesting and suggestive.

A Study of the Ethical Principles, by JAMES SEETH. Chas. Scribner's Sons, New York, 1898. pp. 470.

This third and enlarged edition makes this one of the very best of modern books upon the subject. It is the outcome of years of continuous reflection and teaching in which the author has sought to re-think the entire subject, and to throw some light upon the real course of thought to ancient and modern times. He has particularly striven to recover and in part restate the contributions of the Greeks, especially Aristotle. He prefers to be called an eudæmonist in the original sense of that term. The present edition contains a new chapter on the nature of ethics which explains the more limited view of this field which further reflection has forced upon the writer. In the second part a new chapter on moral progress has been added, and a sketch of literature is appended to each chapter.

Theories of the Will in the History of Philosophy, by ARCHIBALD ALEXANDER. Chas. Scribner's Sons, New York, 1898. pp. 357.

The writer, formally Professor of Philosophy in Columbia College, here attempts the concise account of the theory of the will from the earliest Greek thought down to about the middle of the present century. He modestly disclaims the title of history because he has only included the theories of the more important philosophers. He holds that historical treatment is indispensable to the proper presentation of the subject, and closes his view with the theory of Lotze with an intimation that it will be continued later. Theory, the author thinks, has tended to make us regard no psychical states as self explanatory, but rather as a result of antecedents or as compounds of simpler elements. This is seen in the tendency to seek the germs of adult psychic states in the infant mind, and even in animals, as well as to take the brain into account. These facts inspire the hope that the genesis of conscious volition may be explained more clearly. Will is considered in the Socratic period, in stoic and epicurian theories, in Christian theology, in British philosophy from Bacon to Reid, on the continent from Descartes to Leibnitz, and in Germany from Kant to Lotze.

The Foundations of Zoölogy, by WILLIAM K. BROOKS. The Macmillan Co., New York, 1899. pp. 339.

This book, which has been for some time awaited with interest, is the fifth in the Columbia University Biological Series, and is rather singularly dedicated to "Hobart College where I learned to study, and I hope to profit by but not blindly follow the writings of that great thinker on the principles of science, George Berkeley." The titles of the twelve lectures, which compose the book, will give the best idea of its wide scope and great importance—Huxley and the problem of the naturalist; nature and nurture; LaMarck; migration in its bearing on LaMarckism; zoölogy and the philosophy of evolution; a note on the views of Galton and Weismann on inheritance; Darwin and the origin of species; natural selection and the antiquity of life; natural selection and natural theology; Paley and the argument from contrivance; the mechanism of nature; Louis Agassiz and George Berkeley.

The Use of Color in the Verse of the English Romantic Poets, by ALICE EDWARDS PRATT. Chicago, 1898. pp. 118.

The use which has been made of color and color terms by Pope, Thomson, Gray, Goldsmith, Cowper, Scott, Coleridge, Wordsworth, Byron, Shelley and Keats, required a careful reading of the poets, and the cataloguing of each usage of color. The results for each poet are classified, first by color groups, and second as distribution among various fields of interest. Nine colors or color groups are used, and twelve fields of interest: viz.—man, dress, manufactured articles, animals, minerals, flowers and fruits, sky, land, waters, miscellaneous objects, color as color, and abstractions. Four hundred thousand lines of verse were read, and two interesting charts are appended, one on color words applied to human eyes, hair, skin; and the second, on those applied to sky, cloud, air, vegetation, hills and deep water. Interest in color culminated in two periods—with Goldsmith representing the lowest stage between them. Scott, Wordsworth and Shelley are near the apex of the first, and the romanticists, after Tennyson, of the second maximal use.

The Sexual Instinct and its Morbid Manifestations from the Double Standpoint of Jurisprudence and Psychiatry, by DR. B. TARNOWSKY. Translated by W. C. Costello and Alfred Allinson. Paris, 1898. pp. 239.

This important work, which first appeared in a briefer form in Russian, in 1885, is here at last translated with a considerable number of fresh observations, which, however, do not especially modify the author's theory. He adopts as the motto of his book the sentence of Havelock Ellis to the effect that now that the problems of religion and labor have been more or less either settled or placed on a practical basis, the question of sex and the race, which rests on it, now becomes the chief problem for coming generations to solve. "Sex lies at the root of life, and we can never learn to reverence life until we know how to understand sex." The book is very attractively printed and bound and contains a frontispiece of the author.

A Plea for Polygamy. Paris, 1898. pp. 280.

This anonymous book, with an edition strictly limited to 300 numbers, is a serious and earnest argument, based chiefly on anthropological rather than biological grounds, that polygamy is practical and in some respects and under certain circumstances not only justifiable, but highly advisable. The author thinks it would prevent a social evil; that monogamy prevents and retards marriage, which is not only a

duty, but an inalienable right for all who wish it, etc. The author's view is extreme, and his accusations against monogamy are bitter; his list of great men in the past who have been open or covert polygamists; his analysis of love and the primary laws of marriage exhibit little scholarship, strong prejudice, and a propensity for extreme views.

Psychology of Sex, by HAVLOCK ELLIS. Vol. I. Sexual Inversion. University Press, London, 1897. pp. 204.

This first volume is largely a translation of the author's work published a year earlier in Germany. From the latter work, however, some matter has been omitted, but more has been added. As a youth, living in an Australian city, where the ways of life were seen, Mr. Ellis resolved, twenty years ago, that one main part of his life work should be to make clear the problems of sex. He has a deep sense of the evils of ignorance, and suppression of efforts that can never be suppressed, but may easily be perverted; and pleads in a preface the cause of sincerity against that of reticence. In the days of the great treatise of Sanchez, the church dealt faithfully with this subject, now it ignores and slights it. A later volume is to be devoted to normal phenomena in this field.

The Determination of Sex, by DR. LEOPOLD SCHENCK. The Werner Co., Chicago, Akron and New York, 1898. pp. 222.

This is called an authorized translation, but the name of no translator is given, neither are we informed where the original papers of the author are found. The style of the translation is exceedingly unsatisfactory, leaving the reader often in great doubt as just what the sentences mean. The general conclusion, however, is plain enough, and is, as is well-known, that sex is determined in the very early months of pregnancy by the presence or absence of sugar in the urine, which the author's extremely delicate phenylhydrazine test detects even the faintest trace of. If the diet during this period can be so determined that no sugar is given off, a male child is the result. If it is thus excreted, a female child is produced. The very wide range, however, of variation in this habit requires a very careful individual study, and the preliminary study of dieting must precede impregnation for some weeks or months.

Die Geschlechts-Bestimmung des Werdenden Menschen, von KARL VON HAGEN. Berlin, S. W., 1898. pp. 60.

This brochure attempts to sum up what we knew and what we know on the predetermination of sex. Assuming the general correctness of Schenck's theory, of which the author gives a somewhat popular statement, he attempts to draw certain practical diathetic rules concerning marriage, food and regimen; supplements the theory with a number of very bold conjectures of his own; and introduces a number of striking psychological conceptions.

Sex Worship: An Exposition of the Phallic Origin of Religion, by CLIFFORD HOWARD. Washington, D. C., 1897. pp. 166.

The author makes sex worship the basis of religion in the world. It was universal and primitive, and has left its mark on, not only all religions, but all languages and institutions. It was inspired by the phenomena of nature, and many of its most formal mysteries were springtime celebrations of the regeneration of life. Now in India there are millions of true Phallic worshippers. Even the highest theologies are its product, and God himself is love. So diverse and changed have been its effects that many really worship at its shrine without knowing it. The author shares what to us is extravagance of

nearly all writers upon this subject, the propensity to see Phallic emblems symbolized everywhere and in everything. His work on the whole is earnest and respectable, but shows few traces of the scholarship really required to treat this subject critically and well.

Psychologie de L'Instinct Sexuel, par LE DR. JOANNY ROUX. Paris, 1899. pp. 96.

This is the best little compend on this great subject that we have seen, and is written with the wide knowledge of the best literature. The first chapter on the basis of sexual need leads up to the conclusion that this takes its rise in every part of the organism, and its exciting cause is similar to that of the desire for food. The second chapter discusses the nervous centres of this function and its relations successively with olfactory, visual, auditory, tactile and gustatory sensations. The third chapter discusses choice, from the lowest animals up to man, with the usual account of the theories of Schopenhauer and Hartmann. The fourth part treats of the higher forms of love, the role of intellectual, moral and emotional qualities, and the evolution of the affectional nature.

Degeneracy: Its Causes, Signs and Results, by Eugene S. Talbot, M. D. London, 1898. pp. 372.

The author is a Fellow of the Chicago Academy of Medicine, and presents here the results of twenty years of labor in a limited medical department of biology. He writes especially for educators and parents, and avoids laying stress on any one cause of degeneracy, nor will he venture to rigidly distinguish abnormality from disease or atavism from arrested development. He considers the stigmata of heredity, consanguineous and neurotic intermarriages, intermixture of races, toxic agents, the school strain, degenerate cranium, nose, face, eye, ear, teeth, and jaw, reversion, mental and moral degeneracy, and illustrates his work with 117 interesting and mostly new cuts. The author is bold, original and suggestive, and his work is a contribution of real and indeed great value, more so on the whole than anything that has yet appeared in this country.

Evolution Individuelle Hérité, par FELIX LE DANTEC. F. Alcan, Paris, 1898. pp. 306.

This is a theory of quantitative variation, and considers the subject under three general heads: I. The monoplastids, both sissipare and those with so-called cyclic evolution. II. The polyplastids, first from the standpoint of their individual evolution, and second from that of heredity. III. He discusses certain facts and theories connected with heredity such as embryogenic acceleration; Cope's diplogensis; Delage's theory of actual causes; with a final chapter on teleology.

Beiträge zur Physiologie des Centralnervensystems, von MAX VERWORN. Jena, 1898. pp. 92.

This first part of a more comprehensive work of the above title is not the so-called hypnosis of animals. The author first describes with some detail the phenomena in birds, mammals, reptiles, amphibia, fish and crabs, with the attempted explanation of Circher, Zeemack, Preyer, Huebel and others; and then characterizes the chief phenomena in man with the theory of the biotomic process which he assumes in neurons. The characteristic posture of hypnotized animals he holds is due to a corrective reflex which requires the muscles involved to remain in tonic contraction, and is the same if the cerebrum is removed. It is all simply the inhibition of voluntary activities that we always observe when strong sensory impressions are intense.

A Mechanico-Physiological Theory of Organic Evolution, by CARL VON NÄGELI. Chicago, 1898. pp. 53.

This little hand-book by V. A. Clark, a student in the University of Vermont, working under the direction of F. A. Waugh, is a very careful summary of Nägeli's mechanico-physiological theory of evolution, and will prove a real convenience to students.

The Formal and Material Elements of Kant's Ethics, by WILLIAM M. WASHINGTON. New York, 1898. pp. 67.

This thesis treats the fundamental principles of the metaphysics of morals, the critique of pure practical reason, and the metaphysics of ethics.

The Basis of Early Christian Theism, by LAWRENCE T. COLE. New York, 1898. pp. 60.

The writer first treats the Greek and Roman theistic arguments, then presents the patristic point of view and the patristic use of the theistic argument, and finally eclectic theism, which he advocates.

Der Hypnotismus, von KARL WACHTELBORN. Leipzig, 1898. pp. 98.

Has hypnotism a place in practical medicine? The author pleads that it is not only utterly worthless, but is a dangerous and in fact a poisonous thing. Even if its first effects are good, the reaction is detrimental to body and soul. It may and doubtless has advanced man's knowledge.

Das Hypnotische Hellsch-Experiment, von RUDOLF MÜLLER. Leipzig, 1898. pp. 322.

This pamphlet is only an extract from two volumes of the above title, and the whole is a plea for the recognition of hypnotism as an important method of scientific psychic investigation.

Die erkenntnistheoretische Stellung des Psychologen, von RUD. WEINMANN. Leipzig, 1898. pp. 252.

This is at the same time a contribution to the foundation of the realistic mode of thought as the only one possible. The realism here represented is confessedly an hypothesis, but one which admits of the greatest simplicity and correctness of description.

Der Ativismus, von DR. I. H. F. KOHLBRUGGE. Utrecht, 1897. pp. 31.

The conclusions of the first paper is that allso-called atavistic anomalies call forth neutral variations (neutral in relation to future race types) either by change or arrest of development. Arrests are caused by disturbances, mostly casual and unknown, occasioned often by unequal distribution of energy of growth. There is a power of variation about the centre, so that variation is always liable to be progressive or retrogressive. The second article consists very largely of a collection of opinions of various eminent biologists upon the subject.

Die vierte Dimension, von DR. LEOPOLD PICK. Leipzig, 1898. pp. 46.

This writer holds that a surface can be conceived as a section of two bodies. The question whence bodies can be thought to have arisen leads logically to a fourth dimension of space. Length, breadth and thickness do not exhaust the essence of body. We never see body, but only surface. Higher creatures might see the partition of the material and immaterial, inner extension or the fourth dimension, and this really unknown numeral of things, which may be defined as *Ausdehnung nach innen*. Man stands on the threshold between the third and fourth dimensions.

Religion und Christentum, von PAUL EWALD. Leipzig, 1898. pp. 39.

Christianity is the ideal of all religions, an affirmation of the supersensuous, and based upon an eruption of the supersensuous into earthly life. It is proper, therefore, to speak of its objective basis, and its best definition is communion with God. Christ is its center, and yet throughout it is the true expression of the inner nature and needs of man.

The Repair of Will-Loss, by JOHN M. TAYLOR, M. D.

In these three lectures, which are abstracted and reprinted from the International Clinics, the writer seeks to illustrate how certain differences arising in puzzling medical situations may be met. He assumes that long protracted ill-health is almost sure to end in misconduct. It is difficult to get hold of those who most need medical aid or reproof. The basis of all treatment is nutritional. Every subject requires very special and detailed study and great personal care.

Early American Philosophers, by ADAM L. JONES. New York, 1898. pp. 80.

This Columbia University thesis presents a concise account of William Brattle, Benjamin Franklin, Cadwalader, Thomas Clapp, and a fuller characterization of the life, education and opinions of Samuel Johnson and Jonathan Edwards.

Psychologische Untersuchungen Über das Lesen auf Experimenteller Grundlage, von BENNO ERDMANN und RAYMOND DODGE. Halle, Max Niemeyer, 1898. pp. 360.

After a brief introductory analysis of the process of reading, the authors résumé the results of previous experimental studies in this field, criticising extensively the work of Cattell, Grashey, Wernicke, and Goldscheider and Müller.

The authors began their experimental study with an investigation of the alternating "reading-pauses" and eye-movements. The eye-movements were observed in a mirror while the subjects (the authors and one other) read familiar or unfamiliar passages from Helmholtz's *Optik* and Lock's *Essay on Human Understanding*. The average angular excursions are found to vary, in the different subjects and texts, from $3^{\circ}45'$ to 5° for comparatively unfamiliar passages, from $4^{\circ}14'$ to $5^{\circ}36'$ in familiar passages. They state the number of fixations required in writing, proof-reading, and in reading a foreign language. By telescope observations on reader's eye the first fixation of each line is found to fall within the line, and the last falls still farther within.

Assuming that the results of the measurements of the speed of eye-movements, made by Dodge and others (as described later), are valid for the reading-movement, the authors argue that during $\frac{1}{3}$ to $\frac{2}{3}$ of the reading-time the eye remains fixated, and that, during the movement, recognition of letters or words is impossible.

The extent of the "reading-field" is next studied, first by having subjects describe periphery of points fixated on printed page; second, and mainly, by "experimental isolation of the reading-pauses and fields." The projection apparatus used in exposing reading matter is described at length, as is also the Dodge Chronograph used in connection with it and already described elsewhere.

Wishing to make the length of exposure as nearly that of reader's usual fixation as possible, while still excluding reacting eye-movement during exposure, the authors proceed to determine the eye's reaction-time in the following manner: From a point first fixated the subject moved to a second fixation point 12 mm. distant on the appearance there of a small letter c. Simultaneously with this c a large

letter O was exposed so as to fall just within the blind spot with the eye in first fixation, but becoming visible the instant the eye was moved. The length of the O's exposure necessary to make it visible was taken as measure of eye's reaction-time, subject to a slight correction. The minimum time was shown to be between 188 σ and 230 σ , the experiments not being extensive enough to determine it more definitely.

The experiment is certainly most cleverly planned. The times given seem rather long, and it is to be hoped that other experiments may assure us of their validity.

Exposures for .1 second of letters and words gave results not very different from those obtained by Cattell and Goldscheider in their shorter exposures. Words were read at greater distances and in shorter exposures than letters, and our authors are thus led to argue strongly against the theory of "Buchstabirend Lesen" even in the modified form in which it seemed to have support in the work of Goldscheider and Müller.

The determining-letter theory of the latter is criticised, and the conditions of the reproduction of the "Wortklangbild" are discussed at length.

The authors then make an exhaustive criticism of the "psychological presuppositions for the derivation of psychic times," and later a special discussion of their derivation for the processes in reading.

The results of the psychometric investigations made at Leipzig by Prof. Cattell are subjected to a merciless dissection, and some of the methods and deductions current in psychometry are given a shaking-up which is interesting, to say the least.

The last two chapters report the results of experiments on adequate sound-reactions to printed letters and to words of various lengths and degrees of familiarity. A careful analysis is made of the psychic components of these reactions, and the relations which they bear to the corresponding processes in actual reading.

In an appendix on "the angular speed of eye-movements," after reviewing the work of Volkmann and of Lamansky, the experiments of Dodge are described.

Dodge used a modification of the Helmholtz-Lamansky method of counting the after-images from light stimuli given at regular intervals during the eye's movement. Movements of 5 $^{\circ}$ required 15 σ ; 15 $^{\circ}$, 30 σ ; 30 $^{\circ}$, 50 σ , nearly twice the times given by Lamansky.

Dodge's clever extraction of apparently valid results from the misused data given in Volkmann's experiments is deserving of notice.

On the whole, this is by far the best and most extensive work thus far on the Physiology and Psychology of Reading. Though it stop short of much more that is essentially important, it treats the subject in some of its most vital parts, and has many good things which cannot be touched upon here. It is to be regretted that the authors have not practiced the American art of condensing, which might well have given us the book's essentials in not more than half its present bulk.

The unity of the work as a treatise on reading would be much enhanced by relegating to the appendix much of the description of apparatus, and by the separate publication of the "criticism of psychic times."

E. B. HUXY.

NOTES AND NEWS.

A STUDY OF TASTE DREAMS.

In a former issue of this JOURNAL (Vol. IX, pp. 413, 414) I gave the results of some experiments on the visual elements of the dreams of my students of psychology in the State Normal School at Westfield, Massachusetts. More recently I have experimented with my students for taste dreams. The conditions imposed by the test required that the mouth be washed out just before retiring, and that a clove be crushed and allowed to remain on the tongue. This was continued for ten successive nights and the details of the remembered dreams written out the morning following. Twenty women fulfilled the conditions of the test and reported a total of 254 dreams.

A strong visual element was reported in 123 of the dreams; a marked auditory element in 17, and a pronounced motor element in 36. Seventeen taste and eight smell dreams were reported. The significant fact in the study is the large proportion of taste and smell dreams. With three of the students cloves were involved—one of "tasting cloves very distinctly," and another of "eating cloves." One dreamed of reciting in school on the importation of cloves from the Molucca Islands. This, she thinks, may have been due to a recent lesson on commercial geography on spices and condiments. Several students reported dreams involving the tasting (and eating) of fruits, the orange being oftenest mentioned. One dreamed of eating nuts and one of eating spiced food. A student who dreamed of tasting wormwood thinks it may have been suggested by a discussion which took place in the psychology class just before the taste experiment was undertaken. I had asked the class to suggest some substance that might be used to induce gustatory dreams and one student had recommended wormwood. A brief discussion followed in which most of the students opposed the selection of wormwood and advocated instead cloves.

Equally interesting were the eight smell dreams. One student dreamed of "smelling and seeing spices." Another "a distinct smell dream of food cooking; can assign no cause, as it was impossible for the odor from the kitchen to reach me." One dreamed of inhaling the fragrance of a cowslip blossom, and she adds that the cowslip had been drawn in school the preceding day. One reports that she dreamed of modelling (in sand) the continent of Asia, and that some sweet-smelling peas grew from the sand. This dream may have been occasioned in part by the fact that she had modelled in sand a relief map of Asia the preceding day, and in part by the planting of some seeds in sawdust a few days before in the science department, in order to study processes of germination.

Several of the more remotely suggested taste dreams were curious. One student, for example, dreamed that the building in which she was sleeping was on fire. She attributes the dream to the last remark which she made to her room-mate before falling asleep: "I shall have to remove this clove; it is burning the mouth out of me."

Comparing the test in the present instance with that previously reported, the following percentages are obtained :

IMAGERY.	TASTE TEST.	VISUAL TEST.
Visual element,	48%	60%
Auditory element,	7%	5%
Motor element,	14%	10%
Gustatory element,	7%	3%
Olfactory element,	3%	1½%

The close relation existing between the taste and smell senses and the comparatively large increase in the percentage of gustatory and olfactory dreams would seem to suggest the peculiar character of the experiment as the cause, especially since several of the dreams involved not merely gustatory and olfactory imagery (*i. e.*, thinking about them), but real tastes and smells.

WILL S. MONROE.

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INDIVIDUAL PSYCHOLOGY: A STUDY IN PSYCHOLOGICAL METHOD.

By STELLA EMILY SHARP, Ph. D., Cornell University.

PART I. HISTORICAL AND CRITICAL.

§ 1. *Individual Psychology.*

The systematic consideration of the problems grouped under the name of "Individual Psychology" is of but recent date. Indeed, the only treatment of the whole subject for its own sake is that contained in a paper published in 1895,¹ by Mm. Binet and Henri. A great deal of work has, however, been done by others, outside of France, which properly belongs to this branch of Psychology; notably the investigations by Prof. Kraepelin and his followers in Germany, whose object is by psychological methods to study the mentally abnormal in comparison with mentally normal individuals. For the sake of this comparison the variations in the psychical processes of normal individuals must, Prof. Kraepelin says, first be studied; but the methods employed are such only as are demanded by the comparison that is the main object of the investigation.²

Many American psychologists have made researches in the

¹ A. Binet et V. Henri: *La psychologie individuelle*. In *L'Année psychologique*, Vol. II, 1895, pp. 411 ff.

In a foot note to the article *La mesure en psychologie individuelle* (*Revue philos.*, Vol. XLVI, p. 113), M. Binet makes the claim that he is the first French psychologist to employ the term "Individual Psychology."

² E. Kraepelin: *Der psychologische Versuch in der Psychiatrie*. In Kraepelin's *Psychologische Arbeiten*, I, 1, pp. 1 et seq. See also Axel Oehrn: *Experimentelle Studien zur Individual-Psychologie*. *Ibid.*, pp. 92 ff.

field of Individual Psychology; but there has been no unity of method among the investigators, nor have the results been systematized or their value estimated. An important characteristic of most of this work, however, is the large proportion of anthropometric tests, which are accorded an importance equal to those which are strictly mental.¹ In the class of the more exclusively psychological investigations may be named the experiments of Prof. Jastrow concerning the community of ideas between men and women, made at the University of Wisconsin, and similar experiments made by Prof. M. W. Calkins at Wellesley College;² as well as a brief study in Individual Psychology by Miss C. Miles, which makes use of the method of the questionnaire.³

It is clear, then, that any treatment of Individual Psychology almost necessarily involves a consideration, more or less complete, of the work done by Mm. Binet and Henri. For this purpose it is well to ask first of all what views these authors take of the scope and relations of Individual Psychology. Individual Psychology, they maintain, takes up the thread of investigation at the point where General Psychology leaves it. "General Psychology studies the general properties of psychical processes, those, therefore, which are common to all individuals; Individual Psychology, on the contrary, studies those psychical processes which vary from one individual to another: it seeks to determine the variable qualities, and the extent and manner of their variation according to the individual." Memory may very well illustrate the point. The law of memory is as follows: the time necessary to fix impressions in

¹ Tests employed by Prof. Jastrow at the World's Fair of Chicago in 1893. Analyzed in *L'Année psychologique*, Vol. I, p. 532. See also J. McK. Cattell, *Mental Tests and Measurements*. *Mind*, 1890, Vol. XV, pp. 373 ff.; J. A. Gilbert: *Researches on the Mental and Physical Development of School Children*. *Stud. Yale Laboratory*, II, 1894; J. McK. Cattell and L. Farrand, *Psych. Rev.*, Vol. III, 1896, pp. 610 ff.; J. Jastrow and G. W. Morehouse: *Some Anthropometric and Psychologic Tests on College Students*. *Am. Jour. of Psychology*, Vol. IV, pp. 420 ff.

² The original account of these experiments appeared in an article entitled *A Study of Mental Statistics*, in the December, 1891, number of the *New Review*, under the heading "The Community of Ideas and Thought-Habits of Men and Women." It appeared also in the article *Community and Association of Ideas: a Statistical Study*, by J. Jastrow; *Psych. Rev.*, I, p. 152 (1894). Similar experiments made at Wellesley College by C. C. Nevers, under the direction of M. W. Calkins, *Psych. Rev.*, Vol. II, p. 363 (1895), gave a different result. A criticism of the latter by Prof. Jastrow appeared in the *Psych. Rev.*, Vol. III, p. 68 (1896). A reply to this by Miss Calkins is found in the same volume of the *Psych. Rev.*, p. 426; and a further reply by Prof. Jastrow, p. 430. Both investigations are discussed and criticised by Amy Tanner, *Psych. Rev.*, Vol. III, pp. 548 ff.

³ *Am. Jour. of Psychology*, VI, p. 534.

memory increases at first proportionally to the number of impressions; but, after a certain limit, the 'time of acquisition' increases more rapidly than the number of impressions. This law of memory is common to all; no one can escape it; but the law does not say that the limit, beyond which the time necessary to retain the impressions is no longer proportional to the number of impressions, is fixed and common for all. This limit is a variable property of memory, and here Individual Psychology comes in, and investigates the subject in its different aspects; it enquires in what measure this limit varies in different individuals, and whether it remains constant in one individual for different kinds of impressions. If *A* and *B*, after one hearing, can remember ten and seven letters respectively out of twelve, can they remember with the same relative readiness an equal number of figures, colors, or what not? Individual Psychology goes on, further, to enquire if there is any relation between the position of this limit and the psychological 'self' of the individual, — as, for example, his age; or between the limit of memory and some other psychical process.

§ 2. *The Psychology of Structure and of Function.*

Before proceeding to a more detailed statement of the problems of Individual Psychology, as set forth by M. Binet and his collaborator, a digression must be made in order to consider a distinction that has lately been drawn between the points of view of 'experimental' and of 'descriptive' psychology. This distinction is set forth by Prof. Titchener in an article entitled "The Postulates of a Structural Psychology."¹ A comparison is here made between the science of biology, in its widest sense, and that of psychology. The former may be approached from any one of three points of view.

"We may enquire," says Prof. Titchener, "into the structure of an organism, without regard to function, by analysis determining its component parts, and by synthesis exhibiting the mode of its formation from the parts. Or we may enquire into the function of the various structures which our analysis has revealed, and into the manner of their interrelation as functional organs. Or, again, we may enquire into the changes of form and function that accompany the persistence of the organism in time, the phenomena of growth and decay. Biology, the science of living things, comprises the three mutually interdependent sciences of morphology, physiology and ontology."

If a more general view is taken, and regard is had for the whole number of living beings as parts of a collective life, we have, corresponding respectively to the three branches named, the more general sciences of taxonomy or systematic zoölogy, the science of classification; oecology, which deals with ques-

¹ *Philosophical Review*, Vol. VII, pp. 449 ff. Sept., 1898.

tions of geographical distribution, of the function of species in the general economy of nature; and phylogeny, the biology of evolution, dealing with the problems of descent and of transmission.

The same principle of division here employed in biology may be applied with equal validity to psychology.

"We find a parallel to morphology in a very large portion of 'experimental' psychology. The primary aim of the experimental psychologist has been to analyze the structure of mind; to ravel out the elemental processes from the tangle of consciousness. . . . His task is a vivisection, but a vivisection which shall yield structural, not functional results. . . . There is, however, a functional psychology over and above the psychology of structure. We may regard mind, on the one hand, as a complex of processes, shaped and moulded under the conditions of the physical organism. We may regard it, on the other hand, as the collective name for a system of functions of the psychophysical organism. The two points of view are not seldom confused. The phrase 'association of ideas,' *e. g.*, may denote either the structural complex, the associated sensation group, or the functional process of recognition and recall, the associating of formation to formation. In the former sense it is morphological material, in the latter it belongs to what I must name (the phrase will not be misunderstood) a physiological psychology. Just as experimental psychology is to a large extent concerned with problems of structure, so is 'descriptive' psychology, ancient and modern, chiefly occupied with problems of function. Memory, recognition, imagination, conception, judgment, attention, apperception, volition, and a host of verbal nouns, wider or narrower in denotation, connote, in the discussions of descriptive psychology, functions of the total organism."

So much for the 'morphological' and 'physiological' psychologies, which are indeed the most important. The other branches of biology have also their counterparts. Ontogenetic psychology, the psychology of individual childhood and adolescence; taxonomic psychology, dealing with the classification of the emotions, impulses, temperaments, the typical mind of social classes, etc.; the functional psychology of the collective mind, which has as yet been but little worked out; and, lastly, phylogenetic psychology, enriched by the labors of the evolutionary school, complete the list.

§ 3. *The Problems of Individual Psychology.*

Mm. Binet and Henri class the problems of Individual Psychology under two main headings. It is called upon:

1. to study the variable properties of psychical processes; to find how, and to what extent, these processes vary from one individual to another; and
2. to ascertain the relation of the processes to each other in a single mind; to find out whether they are mutually dependent, or whether there are some fundamental processes upon which all the others depend.

A. The First Problem of Individual Psychology.

The first problem has two aspects, according as emphasis is laid upon the processes themselves, or upon the individual who experiences them. The first aspect is the one with which Individual Psychology must necessarily start. How and to what extent mental processes vary from one individual to another is the question which must be answered, to furnish, as it were, the materials for further investigation. Then we may go on to ask if these variations follow any regular laws, corresponding to the classification of individuals into groups by profession, sex, age, etc.

A considerable number of independent investigations have been made in the line of this first problem of Individual Psychology, under both its aspects. Sensations are the processes which have been subjected to the greatest amount of research, on account of their value for some practical end. The tests in regard to individual variations in visual sensations, such as color blindness, which have been made among engineers, pilots, and in other professions whose members are called upon to recognize color signals, are experiments of this kind. Mm. Binet and Henri state, as the result of a brief historical survey of the work in this field, that "the individual differences for sensation are very feeble and insignificant in relation to the differences in the higher faculties." Hence much of the work done is of comparatively little value for Individual Psychology, which seeks to characterize individuals and classes according to the variations which they exhibit in the mental processes composing the 'real' or 'actual' mind of every-day life.

Other researches have been carried out, in which the emphasis has been laid, not upon the variations themselves, but upon their relation to the individual; and the individual's mental processes have been studied in reference to the class to which he belongs. The investigations of Prof. Jastrow and Miss Calkins regarding the Community of Ideas in men and women (mentioned above) come under this head. The investigations of what may be called 'professional psychology' also belong here, and would be of the highest importance for Individual Psychology were it not that they fail to apply a strictly scientific method. As it is, however, they are rich in suggestions of more exact work, and may thus lead to systematic research along the same lines.¹

¹ L. Arr  t: *Psychologie du peintre*. Paris, 1895. This considers anthropological as well as psychological traits, and the author has drawn his material largely from literature, biographies, and documents of all kinds concerning artists of every time and country. Owing to the imperfect nature of the material, the conclusions are

The question now arises whether the first great problem of Individual Psychology should be classed as an enquiry of 'structural' or 'functional' psychology. In the first place, is the *material* with which the Individual Psychologist works the same as (or similar to) that which lends itself to the investigation of the Experimental Psychologist? The Experimental Psychologist takes mental processes in as simple a form as he can find them. By means of laboratory methods, he exercises the most rigid control over conditions, in order that all complicating factors may be excluded, and that the result may represent as nearly as possible the working of the elemental factors. Thus the Experimental Psychologist, acknowledging that a pure sensation is an abstraction,—that it never occurs in our concrete experience,—yet endeavors by artificial means to secure in his subjects states of consciousness in which the desired sensations are sufficiently isolated from their respective contexts to give information as to their properties and the laws governing the variations of these properties.

Does the Individual Psychologist adopt a similar method of procedure? Is it his aim to take the simplest existing processes, in order to investigate any possible individual variations, and thus to account for unlike results from the building up of unlike materials? It is by the answer to this question that two groups or schools of Individual Psychology are differentiated. M. Binet and the French psychologists answer "no;" Prof. Kraepelin and the German psychologists answer "yes." The American psychologists make no explicit statement on the subject, but their practice is rather with the German than with the French school. The German school maintains that, at least for the present, only simple mental processes can be studied with the exactness necessary for scientific work. "Die Probleme der Individual-psychologie können bisher nur in

necessarily exceedingly general. Prof. James denies this work the adjective 'scientific.'

L. Dauriac: *Psychologie du musicien*, Articles I-VII. *Revue philos.*, Vol. XXXV, pp. 449, 595; Vol. XXXIX, pp. 31, 258, 404; Vol. XLII, pp. 1, 155.

Harmon: *Psychologie du militaire professionnel*. Paris, 1894. This is a work which belongs to sociology more than to psychology. It traces the moral effects of army life and the reaction of these upon society.

A. Binet et J. Passy: *Études de psychologie sur les auteurs dramatiques*. *L'Année psychol.*, I, pp. 60 ff. The creative imagination is here the chief subject of investigation. A number of French dramatists give information, either by word of mouth or in writing, regarding the composition of their works; the choice of subject, the method of literary labor, the 'furniture' of the mind during inspiration, etc. The 'interview,' like the questionnaire, is a valuable auxiliary method; but the results therefrom cannot claim the validity of the stricter laboratory procedures.

ganz einfachen Formen psychischen Geschehens gesucht werden."¹ Mm. Binet and Henri make explicit and repeated statements of the opposing standpoint in the article which we have been considering. On p. 417 is found the passage here translated. "The higher and more complex a process is, the more it varies in individuals; sensations vary from one individual to another, but less so than memory; memory of sensations varies less than memories of ideas, etc. The result is, that if one wishes to study the differences existing between two individuals, it is necessary to begin with the most intellectual and complex processes, and it is only secondarily necessary to consider the simple and elementary processes."

An examination of particular investigations which have been made by representatives of these two schools will enable us to judge whether the principles of each have been strictly adhered to. Kraepelin and Oehrn must be taken as the German representatives. Kraepelin, in the first number of the 'Psychologische Arbeiten,' lays down the principles, methods and aims of the work which he proposes to undertake. Oehrn—in part, at least—carries out these methods, and the results are embodied in the second article of the same number of this periodical.

Since for Kraepelin men are divided into two great classes, the mentally normal and the mentally abnormal, all individual differences are summed up for him under the one great category of *mental capacity*. It is his aim to learn as much as possible about the psychology of the abnormal mind. For this purpose investigations of the normal mind are first necessary, and then further investigations of the normal mind, under certain abnormal conditions which produce consciousnesses comparable to those normally present in the insane. The differences in mental capacity, therefore, which Kraepelin considers subject to experimental investigation, are those which are most directly connected with physical conditions. The kinds of mental capacity to be thus investigated he classes under the three heads of capacity for the perception of sensory stimuli, for the association of ideas, and for voluntary movement. The psychophysical *conditions* which are studied under these three heads are the influence of practice and the persistence of the effects of practice, the capacity of the special memories, the influence of fatigue and the capacity of recovery from fatigue, the depth of sleep, and the capacity for concentration of the attention. Prof. Kraepelin states that this list is as far as can be from exhausting the conditions which it is possible and even necessary to determine experimentally; but he affirms

¹ Max Brahn: *Zeit für Ps. u. Ph. d. Sinnesorgane*, Vol. XII, p. 280.

that it is upon the basis of an investigation such as this that the study of personalities must be founded.

The operations, suggested by Kraepelin and adopted by Oehrle, that are chosen as affording means for the investigation of these conditions are as follows: 1. Perception: the counting of letters, the search for particular letters, proof reading. 2. Memory: the learning of twelve nonsense syllables, and of series of twelve figures. 3. Association: the addition of series of one-place numbers. 4. Motor functions: writing from dictation, and reading as fast as possible.

The time aspect alone of these operations is noted experimentally. The absolute durations of the processes, and their mean variations, give information in regard to the general mental capacity of the individuals tested, and to the relation of the processes to each other in respect of complexity, etc.

The fluctuations in the rate of the processes during periods of continuous work, or after stated intervals of rest, show the influence of practice in increasing the efficiency of work, of fatigue in decreasing this efficiency, and of rest in increasing the efficiency by means of the removal of fatigue, or decreasing it by obliterating the effects of practice, according to the length of the rest interval. A strict numerical expression is given to all the facts thus deduced. "If we wish to be instructed," says Oehrle (p. 144), "concerning the psychical efficiency of a person, we ask first concerning the quantity of work he can do in a certain time, or the time necessary to do a certain amount of work. We shall, therefore, have to consider in the first place the individual differences in the absolute duration of the functions investigated" (*i. e.*, the average time, in thousandths of a second, that it takes to count one letter, to read one syllable, to write one letter, to make one addition, or to learn one number or syllable). "The second question is as to the quality of the work, by which alone the value of the quantity may be estimated." A direct answer to this latter question Oehrle does not attempt to give in his work, but considers the omission of secondary importance, since all of his subjects had attained a degree of education where large differences in the quality of the particular processes tested could hardly enter. "Further, it is of importance," he continues, "for judging an individual, to know if he is in condition to work with constancy. If this is not the case, the quality of the work must suffer on the one hand, while on the other, large fluctuations will also indicate a diminution of quantity, since they are to be taken as evidences of fatigue. Hence the more numerous and larger the fluctuations are, the lower must be our estimate of the psychical energy of the individual considered." The mean variations in time give numerical representations of these fluctuations.

" Finally, we have to ascertain how the subjects behave in regard to practice and fatigue. It is necessary to distinguish between that practice which enters into a single experiment, . . . and the permanent practice which manifests itself, in a repetition of the experiment, by a shortening of the time necessary to perform the work." The mean variations and the relation of practice and fatigue in an individual are considered as of more importance for judging his capacity than the absolute duration of his work. Tables are given, presenting the numerical results in each of these regards, obtained from every one of Oehrn's ten subjects. From the Tables a comparison of the subjects could be made; but Oehrn leaves this comparison to be made by the reader. He is chiefly concerned to show that by the aid of the method he has described it is possible to obtain a conception of the psychical status of an individual. To establish a normal status would be the task of far more extended investigations.

Contrast with this work in Individual Psychology an investigation made in France, by Mm. Binet and Henri, on Memory for Sentences (Memory for Ideas).¹

In the memory of figures or letters, it is chiefly auditory, visual or tactual sensations that are retained: the memory is one of relatively simple conscious elements. Memory of isolated words approaches this in its essential character; for, though the sense of the words enters here, and the memory is partially a memory of ideas, yet it is impossible in experiments upon the memory of isolated words to determine how much influence upon the subject's power of recall is due to the sense of the words, and how much is due simply to the subject's desultory memory, or memory of separate, unconnected impressions. Hence it is necessary to investigate the memory of ideas by itself.

Mm. Binet and Henri chose eight sentences, or closely connected groups of sentences, ranging in length from 11 to 86 words. These sentences were read before the pupils of several classes in four elementary schools in Paris. The children were required to reproduce the sentences in writing immediately after hearing them. The attention of the pupils was properly directed, since an explanation of the requirement was given to them in advance. The main work in the investigation was,

¹ A. Binet et V. Henri: *La mémoire des phrases (Mémoire des idées)*. In *L'Année psychologique*, I, 1894, p. 24. This article appeared before that on Individual Psychology by the same authors, and the investigation is not explicitly termed an investigation in Individual Psychology. The test employed is, however, closely similar to one proposed in the latter article, and represents very fairly the kind of material which the writers believe Individual Psychology should employ.

of course, the interpretation of the results handed in by the pupils. The number of children submitted to the experiments was about 510.

One of the chief difficulties in the interpretation of results lies in the fact that not every word in the sentence or sentences represents an independent idea. One cannot say that there are just as many ideas in the sentence as there are words. Pronouns, articles, prepositions, etc., have no meaning apart from other words with which they are closely connected; and short phrases are remembered as a single idea. Hence it became necessary to separate the sentences into word-groups, each group representing as nearly as possible one idea. Here is an example of this division of one of the shorter sentences: a sentence of 20 words and 8 groups of words:

Le petit Émile | a obtenu | de sa mère | un joli | cheval mécanique |
en récompense | de sa bonne conduite | à l'école. |

In the longer sentences or series of sentences the division becomes more difficult and assumes a more or less arbitrary character. A passage of 60 words and of 19 groups may show this:

Une vieille paysanne | âgée de 64 ans, | la veuve Mouillet, | qui
habitait une petite maison | sur la route déserte | des Recolets | avait
conduit | son troupeau | dans les champs. | Pendant qu'elle faisait de
l'herbe pour ses animaux | une vipère | cachée derrière | les fagots—
s'élança sur elle | et la mordit | à plusieurs reprises | au poignet. | La
pauvre femme | en est morte. |

The results obtained from the investigation were, in brief, these. 1. Memory for sentences (or ideas) shows a slight but constant increase with age. This was ascertained from the fact that in the higher classes more groups of words were completely retained, and fewer words totally forgotten,—*i. e.*, entirely left out, without any substitution whether right or wrong,—than in the lower classes where the pupils were younger. 2. The memory for sentences is, in certain fixed conditions under which these experiments were tried, twenty-five times superior to the memory for isolated words. 3. The number of forgotten words increases rapidly with the length of sentences or series of sentences; for a sentence of 20 words (8 groups) it was $\frac{1}{3}$, while for a series of 80 words (24 groups) it was $\frac{1}{2}$. 4. The losses of memory fall upon accessory parts of the sentence, not upon the essential parts, *i. e.*, not upon the parts that are logically or psychologically important. 5. In short selections there are more substitutions of synonymous words than there are completely forgotten words, but in long selections the reverse is the case. In short sentences, though the particular words may be forgotten, the ideas are remembered, and the child invents his own terms. We find, therefore, a large number of synonyms. In long selections, however, the

ideas themselves are too numerous to be remembered, and the completely forgotten words outnumber the synonyms. 6. Children have a tendency to simplify the syntax, and to replace the words read to them by other words taken from their own more familiar vocabulary. This Mm. Binet and Henri call 'verbal assimilation.' 7. When sentences are somewhat long, children show a tendency slightly to alter the meaning of the sentence. These alterations are frequently by way of additions, and may be of two kinds, intellectual and emotional.

It will be seen that the only factors in this problem that lend themselves to numerical expression are (1) the *quantity* of words or groups remembered, substituted, or forgotten by any pupil; (2) the number of pupils who remember or forget any particular word or group; and (3) the age of the pupils who remember best or worst.

The character of the material employed in this investigation is clearly and confessedly of the complex type. Although the sentences are mainly concrete, as suited to the child mind, they yet imply a considerable faculty of generalization and a synthetic power of attention in combining the various ideas into a situation. The mental processes involved are therefore highly complex, and the investigators have here used the material which they assert to be most suitable for the examination of the Individual Psychologist.

Has the material of the German psychologists the opposing character of extreme simplicity? The only simplicity that Kraepelin claims for his work is simplicity of *method* (method of continuous work). This has to do, not with the measurement of single independent acts, but with the continuous performance of regularly connected similar acts. The acts or processes themselves are not simple. Oehrn has analyzed each into three phases: the centripetal phase, or process of perception; the central phase, or process of association; and the centrifugal phase, or process of movement. The three phases vary in importance and duration in the different kinds of operations used in the experiments, and the fluctuations observed in continuous work may therefore be due to alterations in that phase of the whole process which is predominantly involved in the exercise in question. This analysis is, however, far from being an analysis into the simplest psychological elements, made for the sake of detecting variations in these elements. We are free to conclude, therefore, that the material used by the Individual Psychologist is, as a rule, less simple than that upon which the general Experimental Psychologist spends his best efforts.

Nevertheless, the distinction between the German and French schools is not invalidated by this statement. There is a con-

siderable degree of difference in the complexity of material employed by these two schools, and there is a still greater difference in method resulting from the difference in material. The more exact methods of the Germans are inapplicable to the tests which the French insist upon as of primary importance to the Individual Psychologist. It is, perhaps, on account of this difference in method that Mm. Binet and Henri, by a slight confusion, exaggerate the difference in the material employed by themselves and by other Individual Psychologists. The specific criticism which they pass upon Prof. Kraepelin's work, however, is not so much that it lacks complexity as that it lacks scope. The experiments are too partial, they say, and for that reason entirely fail to characterize an individual.¹

The position of Mm. Binet and Henri may be more clearly understood if we notice briefly some of the 'mental tests' proposed by American psychologists. The tests given by Prof. Jastrow at the World's Fair at Chicago² are among the most complete. There are here five different experiments for touch and cutaneous sensitivity; five experiments for sight and touch together (such as the equalizing of movements by sight); twelve or more experiments for sight alone, including appreciation and division of lengths, rapidity and acuteness of vision, etc. Other tests have to do with memory for letters, lines, colors and forms, and with simple reaction times. Place is also given to anthropometric tests of height, development of the head, and the relation of mental to physical development, etc. It will be seen that these experiments have chiefly to do with sensations and simple movements. Even the memory tests have regard to memory for sensations rather than to memory for ideas.

Other lists of tests given by American psychologists show the same characteristics. Prof. Cattell, in an article in *Mind*,³ gives the results of two different series of tests, one numbering ten and the other fifty. The first series is as follows: (1) pressure measured by the dynamometer; (2) maximal rapidity of arm movement; (3) minimal distance between two points on the skin which can be perceived as two; (4) pressure necessary to produce pain; (5) least perceptible difference for weight of 100 gr.; (6) time of simple reaction to an auditory impression; (7) time necessary to name a color; (8) division of a length of 50 cm. into two equal parts; (9) reproduction of an interval of ten seconds; and (10) number of letters retained after a single hearing. The longer series is analogous to this, the same relative importance being given to the elementary processes.

¹ P. 432.

² These are analyzed in *L'Année psychologique*, Vol. I, p. 532 (1894).

³ *Mental Tests and Measurements*. *Mind*, 1890, Vol. XV, p. 373.

The "Researches on the Mental and Physical Development of School Children," by Dr. J. A. Gilbert,¹ employ the following tests: (1) muscle sense; (2) sensitivity to color differences; (3) force of suggestion; (4) voluntary motor ability; (5) fatigue; (6) weight; (7) height; (8) lung capacity; (9) reaction-time; (10) discrimination-time; and (11) time-memory. All these tests are subject to exact numerical measurement. The muscle-sense was measured by the least perceptible difference in gr. of lifted weights; sensitivity to color-difference was measured by the shades of red-colored fabric picked out by a child as being alike (every piece of fabric being in reality slightly and measurably different in shade); force of suggestion was determined by the difference in gr. between two weights of the same bulk but unequal weight, which the child picked out as being equal respectively to a weight large in bulk and one small in bulk which (unknown to the child) were of equal weight. For the experiments on voluntary motor ability and fatigue, reaction-time, discrimination-time and time-memory, Dr. Gilbert constructed an apparatus which he calls the reaction-board. This board holds a magnetic tuning fork, vibrating one hundred times per second; a double-post switch; a stimulating apparatus; a reaction key; a tapping apparatus; a commutator, and an Ewald chronoscope. The electric current is supplied by two Grove batteries. Voluntary motor ability was measured by the number of taps the child made on the tapping apparatus in five seconds, and fatigue by the per cent. of loss of rapidity of tapping after the movement had been continued for 45 seconds. Reaction-time and discrimination-time were measured by the chronoscope, in hundredths of a second. The time-memory was measured by allowing the chronoscope to run a certain length of time, and then starting it a second time, and requiring the child to press the key when the second running had lasted as long as the first. The difference between the two periods of time marked the accuracy of the time-memory. Weight, height, and lung capacity were measured by standard instruments suited to these purposes.

The detail which has been given is sufficient to illustrate the difference in material and method between the French Individual Psychologists, and those engaged in similar work in America. It may be said, therefore, in general, that there is a wide divergence in opinion and practice among the investigators of Individual Psychology, as to whether the first problem of the science, on the score of material and method, is properly of a structural and morphological character, or whether it should be classed as belonging to a functional or 'physiologi-

¹ *Studies from the Yale Psychological Laboratory*, II (1894), p. 401.

cal' psychology. The Americans make it approximate to the former character; the Germans seem to favor the former in regard to method, but hold a middle position in regard to material; while the French psychologists depart as far as possible from the point of view of morphology, both in material and in method. The American view is founded upon no explicit theory of Individual Psychology. It may, therefore, be temporarily set aside. Considering only the French and German psychologists, we find that Individual Psychology seems, on the whole, rather to fall outside of structural psychology. It might be, however, that strict analysis of the results obtained from the study of complex processes would give information in regard to the ultimate elements. Is this, in reality, the case? The outcome of the researches we have hitherto noticed would seem to indicate a negative reply. But it is too early, yet, to look for an entirely decisive answer. Until a more thorough investigation of the methods proposed by Individual Psychology, or possible to it, is carried out, the question must be left undecided.

B. The Second Problem of Individual Psychology.

Individual psychology has to study not only the variations of mental processes from one individual to another, and the relation of these to individuals or classes of individuals, but also the relations of the mental processes to each other in the mind of one and the same individual. Are all the mental processes definitely related and correlated? Is there one process more important than all the rest, so that a variation in this process involves a perfectly definite variation in all the other processes? Or, on the other hand, are there a large number of mental processes, practically independent of each other, and capable of assuming an almost infinite variety of combinations in as many individuals?

Again we have to ask whether this inquiry by Individual Psychology is of a structural or physiological character. The answer is not far to seek; it is, in fact, implied in the very form in which the questions of this second problem clothe themselves. It is the investigation of the relation to each other of the various *ways of working* of the psychological organism. It is, therefore, the psychological problem which corresponds to the general problem of physiology. As the latter asks what are the basal functions of the living physical organism, so the former seeks to find in the mental sphere those activities whose relations to each other and to the psychological organism are analogous to those existing between functions in the sphere of physical life. The problem may, and does, imply analysis; but it is an analysis of which the common activities of every-day

life form the starting point, and their better understanding, the goal. The atomistic point of view is abandoned, and the mental activities of man are taken, as it were, in the large; and the various relations of these activities, partially seen and understood by common observation, are confirmed, explained, and rendered explicit by the use of the experimental method. This is the task laid down as the second problem of individual psychology,—a task which belongs, therefore, to the psychology of function.

The difficulties attendant upon an investigation of the questions involved in this branch of Individual Psychology are very great. The mental processes which make up the sum of everyday psychical activity are of so complex a nature that it may be doubted whether experimentation can be applied in such a way as to yield results which meet the requirements of scientific precision. Mm. Binet and Henri have, however, discussed three methods by which investigation may be carried on. (1) The first method is that of abnormal cases; wherein advantage is taken of instances where there is extreme development or enfeeblement, or even loss, of some psychical processes, to study the consequent modification of other processes. Where there is a loss of memory, *e. g.*, we may try to find the effect of such loss upon imagination, power of concentration of the attention, etc. That is to say, the object is to ascertain whether the presence of an abnormal activity involves a definite deviation from the normal on the part of other mental processes. The collection of a large number of investigations of this kind would show the relation in which these processes stand to one another. There is, however, a difficulty. How shall we determine the *amount* of deviation from the normal, which one process must possess in order to entail a corresponding deviation of other processes? This question must be answered by means of experimentation, before the more general problem can be solved.

This method has been employed to some extent, and has furnished some important information. By its means was ascertained the fact of the independence of the partial memories;¹ the fact, *i. e.*, that we "can have an extraordinary memory for figures, without in the least excelling in memory for letters, or colors, or any other impressions whatever." Moreover it has shown that a total loss of some partial memories may fail to show any influence upon the other partial memories.²

(2) Another method, one that is applied to normal indi-

¹ By A. Binet: *Psychologie des grands calculateurs et joueurs d'échecs*.

² Mm. Ribot and Charcot, quoted by Binet and Henri.

viduals, may be stated thus: "In a single individual one may vary a psychical process, and see if this variation involves changes in other processes in the same individual." For this purpose only those processes are chosen which are useful for the comparison of individuals. Experiments upon sensations, manner of fatigue, etc., are thus eliminated. The practical application of this method is attended with great difficulty, owing to the complexity of the conditions. It depends, evidently, upon the possibility of placing an individual, by artificial means, in such a condition that certain mental processes shall be performed in the way in which they take place normally in certain other individuals. An individual who gave a quick reaction time, owing to great power of attention, might, by having his attention artificially distracted, lengthen his reaction time until it corresponded to that of other individuals who normally gave long reaction times from small power of attention. Given a constant correspondence between length of reaction time and degree of concentration of the attention, and the rapidity of reaction of an individual might be taken as an index of his power of attention.

This method has been applied by Prof. Kraepelin, in his investigation into the influences of slight poisons upon certain psychical processes: these poisons producing, in a normal individual, effects analogous to those caused by certain mental diseases in their early stages. Valuable as the method may be in theory, however, its range of application is necessarily limited, and it is, according to Mm. Binet and Henri themselves, more useful as a source of suggestion than as affording specific results.

(3) The third method, which is likewise the simplest and most practicable, is that in which the experimenter chooses in advance a number of psychical processes, and proceeds to study them in several individuals, noting whether the individual differences in the different processes run parallel to each other, and correspond in a regular manner. From such correspondence he can infer the existence of a more or less close relation among the different processes. The experiments of Oehrn and Gilbert, which have been commented on above, are partial applications of this method, as are also the various 'mental tests' proposed by American psychologists. The disadvantage of the latter, according to Mm. Binet and Henri, is that they are calculated to give but little information in regard to the second problem of Individual Psychology, since they pay but slight regard to the complex processes. The method itself has the advantage of serving equally well for the study of either of the two problems of Individual Psychology. The results may be looked at with a view to ascertaining the variations which occur in the chosen processes from one individual to another,

and the relation of these variations to the sex, age, profession, etc., of the individuals in whom they are observed; or the results may be studied in regard to the correspondences which may constantly manifest themselves between the different processes in any single individual. For the latter point of view, however, it is necessary that the processes chosen for investigation shall be of that complex character which distinguishes the every-day activities of one individual from those of other individuals. Mm. Binet and Henri affirm this with emphasis. They say (p. 426): "Is it necessary to know that *A* has a finer tactual sensibility than *B*, that he can distinguish between two colors better than *B*, or that he can move his arm faster than *B*, in order to distinguish these individuals from each other? Certainly not. On the other hand, how could one try to characterize them, and to distinguish them from each other, if one had no data concerning their imagination, their memory, their power of attention, their power of observation, their power of analysis, their reasoning, their stability of will, their affective life, etc.?" That these activities are more difficult to investigate than the elementary activities is a disadvantage which these authors believe is of comparatively small importance, since in the "superior psychological faculties," to use their terminology, there are stronger individual differences, and hence the need of precision is not so great.

The method of 'mental tests' is that most available for present use, and, since the particular tests which have been proposed by others are considered by Binet and Henri to be inadequate, these authors give a long and detailed list of tests which they consider will bring to light the strongest individual variations, a knowledge of which in one individual will give a general idea of that individual, and serve to distinguish him from others belonging to the same class.

The tests are grouped under the following heads. I. Memory: (a) visual memory of geometrical design, (b) memory of sentences, (c) musical memory, (d) memory of colors, (e) memory of figures. II. Nature of mental images: (a) letter squares, (b) interrogation. III. Imagination: (a) passive imagination (method of blots and of abstract terms), (b) constructive imagination (development of a theme), (c) imagination of design (composition or completion of a picture), (d) literary imagination (construction of sentences using given substantives or verbs). IV. Attention: (a) duration of attention (series of reaction times or successive reproduction of lengths from memory), (b) range of attention (counting of metronome beats and execution of several simultaneous acts). V. Faculty of comprehension: (a) talent for observation (analysis of a machine), (b) fineness of discrimination (discrimination of syno-

nymys and criticisms of sentences). VI. Suggestibility: (a) of sensations and perceptions (identification of lines and perception of odors), (b) of imagination (expectant attention), (c) of emotivity (apprehension, fear), (d) of involuntary and unconscious movements. VII. Æsthetic sentiment: (a) preference in geometric forms, colors, perfumes, (b) questionnaire. VIII. Moral sentiments (method of pictures). IX. Muscular force and strength of will (persistence in muscular effort). X. Motor skill and sureness of eye.¹

The general conditions which the proposed tests must fulfill are given by the author as follows. They should be simple, that is, they should require little apparatus; the time for the whole number of tests should not exceed an hour and a half for one individual; they should be varied in such a way as to avoid fatiguing the subject; and the means of determination should be as independent as possible of the personality of the experimenter, in order that the results obtained by one experimenter may be compared with those of another.

A casual reading of the descriptions given of the various tests will convince one that the first condition is fulfilled. The apparatus required are small as to number and simple in character. In regard to the requirement of time, however, the result is not so satisfactory. One test alone, that of the memory of sentences, of a progressively abstract character, could take scarcely less than a quarter of an hour: add to that the ten or fifteen minutes allowed for the development of a theme for constructive imagination, and it will be seen that the time is going far too quickly to allow an application of even a majority of the remaining tests. This fact has a bearing also on the next requirement, that there should be as great a variety as possible in the tests in order to avoid the disturbing effects of tedium and fatigue; for, although a certain variety in the experiments is advantageous for keeping up the interest of the subject, yet a crowding of many dissimilar tests into a brief space of time is equally disadvantageous. The aim is, of course, in these experiments to have the processes tested as nearly like those of every-day life as possible, and a monotonous repetition of exactly similar operations would defeat this aim. There is, how-

¹A number of these tests were applied by Dr. É. Toulouse in the psychological part of the investigation of which M. Emile Zola was the subject. The whole investigation is described by Dr. Toulouse in his book *Enquête médico-psychologique sur les rapports de la supériorité intellectuelle avec névropathie*. Paris, 1896. Inasmuch as the psychological tests employed are not the main reliance of the investigator in the formation of his judgments, but are considered only as giving confirmation to the judgments based on general observation of the subject, of his written works, etc., the essay can scarcely be called a purely experimental study of Individual Psychology.

ever, in every-day life, as the mind turns from the performance of one set of operations to another, a certain period of preparation. If the attention is, as it were, wrenched from one sort of activity to another very different sort, without any preparation, confusion is apt to ensue.' So in the activities experimentally controlled, too sudden changes do not conduce to the most favorable conditions of the attention. In the tests laid down by Mm. Binet and Henri, therefore, the requirement of variety in arrangement is a just one, for the attention demands a frequent change of object. A radical change of object, however, requires time for the readjustment of the attention to the new conditions; and time must, therefore, be provided in sufficient measure. As much effort is expended and consequently as much fatigue is produced by working hard as by working long; it is poor economy to save time at the expense of effort. The chief reason why Mm. Binet and Henri make the requirement of brevity for the tests is the practical difficulty of securing the subject of experimentation on more than one occasion. This difficulty does not seem to be an unsurmountable one, as it probably would apply only to a restricted number of cases. When such cases do occur, judgment must be exercised in balancing the rival claims of variety or range of tests and of sufficient time to perform the tests most efficiently.

Whether the last requirement is fulfilled, whether, that is, the results of different experiments using these tests are perfectly comparable, is a question which can be decided only upon a further consideration of the individual tests. Owing to the complex material which is investigated, it is easy to see that this condition is a hard one to comply with perfectly. M. Binet treats of this subject in a separate article, *La mesure en psychologie individuelle*.¹ There is a quantitative aspect to most of the experiments, and this may be measured with a fair amount of accuracy. There are two possible methods of measurement, the first being a measurement of the results obtained while the test remains the same. Thus in memory, for example, accuracy may be measured by the amount by which the reproduced series falls short of the original series. The rapidity with which a certain amount of work is performed may measure some other processes. Enumeration and evaluation may also give numerical results, but of much less precise a character. The second method of measurement consists in a graduation of the experiment, the results being reduced to a maximum of simplicity. An example of this method would be, finding the maximal number of objects which a subject could retain after looking at them for five seconds. First three objects are shown,

¹ *Revue philos.*, Vol. XLVI, Aout, 1898.

then four, then five, etc., until the maximum is reached. The gradation of tests in terms, not of number but of kind, is difficult, as, *e. g.*, where sentences become more and more abstract.

M. Binet states that the measurement of which he is speaking is not a physical or absolute measurement, but only a method for the classification of individuals. There is no fixed standard by reference to which all individuals may be evaluated; but of certain specific individuals one can say that under certain fixed conditions, when A's memory of isolated words is 12 and that of B is 6, A's memory of isolated words is better than B's. It would be unwarranted, however, to say that A's memory for isolated words is exactly twice that of B, since all the words may not have the same value for consciousness.

All methods of measurement have for their aim the classification of all the individuals tested according to a quantitative scale. The tests, however, bear another aspect beside that of quantity. Quality must also be considered; and here it is necessary to class individuals according to different categories. M. Binet does not go into detail in regard to the possibilities of such a classification, but he suggests that the tests might differentiate literary and scientific types, or emotive (moral or egoistic) types.

PART II. EXPERIMENTAL.

§ 4. *Description of Tests.*

The following experiments were undertaken during the academic year '97-'98 as a study of Individual Psychology based, in general, upon the theories, and to a large extent upon the specific suggestions of Mm. Binet and Henri, as contained in their article *La psychologie individuelle*. The theory was provisionally accepted that the complex mental processes, rather than the elementary processes, are those the variations of which give most important information in regard to the mental characteristics whereby individuals are commonly classed. It is in the complex processes, we assumed, and in those alone, that individual differences are sufficiently great to enable us to differentiate one individual from others of the same class. Many of the particular tests recommended by the French psychologists were also adopted, but were considerably modified in the general conditions of their application by the purpose of our own investigation.

The aim of this work was (1) to ascertain the practicability of the particular tests employed, and (2) to answer the more general question as to the tenability of the theory upon which they are based, in so far as this can be judged by the experiments. In other words, we desired to assure ourselves whether

investigations of this kind enabled us to advance, at least, toward a solution of the problems of Individual Psychology; whether those individual variations, and those correspondences which are necessary for classifying individuals, and for estimating the relative importance of the several processes in a single individual, could thereby be discovered.

In view of these aims, and also of the criticisms of the general conditions demanded by Mm. Binet and Henri for the application of the method of 'tests,' the procedure was necessarily different from that laid down by these psychologists. To make sure that the tests give real individual differences, and not chance variations, it is necessary to apply them to the same individuals, not once, but several times, in order that it may be observed whether the variations in the different individuals maintain a constant relation to one another at various times and, consequently, under varying subjective conditions. Instead of single tests, therefore, series of similar tests for each activity were arranged. This necessitated, of course, a very large extension of the time beyond the limit allowed by the French investigators. The advantages of a short period of varied experimentation were, however, to a large degree attained. The experimental work of each subject was divided into periods of one hour each, and separated by intervals of one week. Within a single hour-period the tests were varied as much as possible. As a rule, only one or two experiments belonging to the series of a particular test were given.¹ In this way the tedium and fatigue due to monotonous repetition of similar operations were avoided, and a fair degree of interest in the work was maintained by the subject. The additional precaution was taken of separating by intervals longer than a week the experiments which were found to be especially trying or disagreeable to the subjects; as, *e. g.*, the development of a theme, or description of a scene or event, employed as a test for constructive imagination.

Since the experiments were of this detailed character, the number of subjects was necessarily restricted. The fact that the investigation was for the purpose of dealing with variations in individuals of *the same class*, afforded a further reason for this restriction. The subjects consisted of seven advanced students in the Sage School of Philosophy, three men (B, E. R, and W. M), and four women (T, G, V. M, and L. R), all of whom had had training in introspection. In the experimental work the subjects were divided into three groups; two groups of two subjects each, and a third group of three sub-

¹ Tests of memory for figures, words and letters, were exceptions to this rule.

jects. This arrangement was made owing to the fact that a large number of the experiments could be performed as readily by two at a time as by one. A group of three presented some difficulty to the experimenter, but not of a serious nature. As a rule, the system of grouping worked well, and caused much saving of time.

Certain of the tests which are especially adapted for collective study were given not only to these groups, but also, by the aid of Prof. Titchener, to the less advanced students taking the undergraduate (junior year) course in Experimental Psychology. The first ten minutes of the lecture hour were usually devoted by Prof. Titchener to this work, the test in every case being conducted by him. Occasional failure of attendance on the part of some members of the class causes a corresponding incompleteness in these results. They are useful, however, as allowing comparison between the less and the more completely trained students.

Though the tests as above described are intensively of greater range than those of Mm. Binet and Henri, they are extensively much more restricted. Only those tests were retained which have to do most directly with the intellectual activities. The æsthetic sentiments were touched upon in a very tentative manner in our investigation, while the moral sentiments, strength of will, etc., were either left out of account altogether, or entered only indirectly as results from tests which were applied primarily for a different purpose.

We are now ready to consider the tests in detail.

I. *Memory.*

1. *Memory of Letters.* Twenty sets of 12 letters each were prepared. As the object was to test the memory for isolated characters, it was desirable to avoid the formation of syllables by successive letters, in so far as this could be done without the total banishment of vowels from the series. The apparatus employed was Jastrow's Memory Drop, by means of which one letter at a time might appear before the eyes of the subject from behind a small opening in a screen. The movements of the drop must be made by hand; the experimenter regulated them by making them coincide so far as possible with the beats of a metronome marking intervals of one second. Each letter, therefore, was exposed to the view of the subject for approximately one second. The experiments took place in this way. The subject was seated at such a distance from the screen that the letters could be clearly seen. A series of twelve letters was then exposed, one by one, as above described. The subject was required immediately to recite the twelve letters in their order. If any mistake was made, the experiment was repeated; the letters being again exposed, and the subject again required to recite them correctly. This whole operation was repeated until the subject was able to name the twelve letters without error. The number of times it was found necessary to expose the series was noted. The answers to questions put by the experimenter in regard to the manner in which the letters were memorized,

as well as observation of the results of the various repetitions, gave information in regard to memory type, and therefore served to supplement the results obtained from another test, the purpose of which was the discovery of the nature of the subject's mental images.

This experiment differs from many others which are to follow, in that it could be performed with only one subject at a time; and also in the fact that several sets of similar series of letters were given to the subject in a single hour.

2. *Memory of Figures.* This test is almost precisely similar to the one above. The chief differences result from the fact that with figures the available characters are fewer, and hence in a series of twelve there must necessarily be some repetitions. Further, the figures, unlike letters, no matter how arranged, make an intelligible combination. The tendency to continue the separate figures is hindered somewhat,—in cases, almost entirely,—by the manner in which they are given successively; but in so far as the tendency to combine is exhibited, it shows an approach toward the memory of ideas. In the preparation of the series of figures it was our aim to avoid putting any two figures in their natural or inverted order, or immediately repeating the same figure. The experiment was conducted in the same manner as that described above.

3. *Memory of Words.*¹ This test has two parts. In the first place the experimenter read a series of 7 disconnected words, at the rate of about two words a second, and the subject was required immediately to recite these in order. If any word was left out of this recital, it was named by the experimenter, and any error was corrected. A second series of 7 words was then read, and the subject was required to recite them as before; then a third series, and so on, until seven series of seven words each had been read and recited. For the second part of the experiment the subject was required to name, in the order in which they occurred to him, as many as possible of the whole 49 words. In the first case one had immediate memory of verbal sounds; while in the recapitulation, which occurred at an interval of at least three minutes from the time of reading of the first short series, the auditory memory of the words had had time to be dimmed, and the sense of the words became a more important factor for memory. The difference in number of words remembered when taken series by series, and when taken as a whole, indicates the relation which subsists between the immediate memory and the memory of conservation in the individual tested. Four sets, each containing 7 short series, were given to all our subjects. The conditions of this test, also, required that one subject should be taken at a time.

4. *Memory of Sentences.* There were given two types of experiments under this head; (a) one in which the passage to be remembered was confined strictly within the limits of a single period, and (b) another, in which the passage was longer, comprising in some cases two, three, or even more sentences. For convenience, we may term the first type that of short sentences, and the second that of long sentences. All the sentences, both long and short, were graduated into five series, according to their degree of abstractness. This graduation was more or less arbitrary. It was difficult to define five distinct degrees; it was occasionally a matter of some little doubt, therefore, which of two successive degrees should claim a particular sentence. Although, however, the difference in abstractness between one degree and the next was often slight, the difference between the extremes of

¹ See A. Binet et V. Henri. *La mémoire des mots.* *L'Année psychologique*, Vol. I, 1894, pp. 1-24. Also E. Toulouse. *Enquête médico-psychologique sur les rapports de la supériorité intellectuelle avec la névropathie.* *Émile Zola.* 1896.

the series could not pass unnoticed. The following series of short sentences will serve as illustration:

I. A huge fire of logs blazed on the great kitchen hearth, and, at a table covered with maps and papers, neatly set in order, the general sat writing.

II. The Chinese regard us as strictly just and truthful, and it is only when we disabuse them of that impression that they show us any disrespect.

III. Whatever comes from the brain carries the hue of the place it came from, and whatever comes from the heart carries the heat and color of its birthplace.

IV. If the Necessitarian doctrine be true, then there is not merely no foundation either for morality or religion, but no basis either for divine or human law.

V. Thought is necessary to make even feeling or sensation to be conscious feeling or sensation; and thought can take place only through discrimination, or perception of difference.

The sentences were chosen from literature: magazine articles, novels, essays, and philosophical works. Fenimore Cooper, Carlyle, Huxley, Leibniz, and many others furnished their quota. Of the short sentences there were twenty sets of five series each, making one hundred sentences in all, ranging from 22 to 28 words in length. Two sets, only, of the long sentences were employed, making ten sentences, ranging from 51 to 64 words in length. All the sentences, both long and short, were given to the seven advanced subjects, while ten sets of short and the two sets of long sentences were given to the juniors.

The experiment was performed in this way. A short sentence was read aloud to the subject at the rate of about three words in two seconds, care being taken that all words should receive, so far as possible, equal emphasis. The subject was required to write down the sentences immediately after the reading. One set of five sentences was usually given to the advanced subjects in a single experimental hour. Sometimes two, and sometimes three sentences were given to the juniors at one meeting of the class. The subjects were requested, after writing the sentence, to underline *once* those words which they felt sure were remembered correctly, *twice* those words of which they were doubtful, and *three times* those words which they felt pretty confident were different from the words dictated. When words had completely fallen out of consciousness, the subjects left *spaces*, the length of which indicated the supposed gap in memory. The sentences were 'marked' under four headings: (1) verbal accuracy, that is, the number of words correctly remembered; (2) order, that is, the number of words occupying their proper position in the sentence; (3) sense, that is, the number of words which, either from the fact that they reproduced those in the sentence read, or that they were essentially synonymous with them, preserved the sense of the original sentence; (4) certainty of memory, that is, the number of words which were marked very doubtful (underlined three times) plus one-half the number of words which were marked somewhat doubtful (underlined twice). All these estimates were reduced to percentages, that the results of all the short sentences might be comparable. This system of marking has its disadvantages, as it depends in some degree upon the personal judgment of the marker. Especially is this the case with regard to the sense of sentences. Substitutions or errors in comparatively unimportant parts of a sentence may change the meaning slightly, but not essentially; still, the sentence can hardly be classed in such a case as reproducing perfectly the sense of the original sen-

tence. As all the sentences, however, were marked by one person, the error throughout is a fairly constant one, and the results obtained from different individuals may be, with justice, compared. The long sentences were intended to conform more nearly to those employed by Mm. Binet and Henri,¹ in the investigation briefly described above in Part I, with the exception that our sentences were graduated according to degree of abstractness. Their method of estimating the results was likewise followed. Each sentence was divided into groups, each group containing one important word with, perhaps, some subordinate words linking it to the rest of the sentence, that the number of groups might coincide with the number of ideas. The necessarily somewhat arbitrary character which this division assumes was before noticed, and is, of course, inimical to precision in results. The points noted in the results were: (1) number of the groups in a sentence which were retained intact; (2) number of words completely forgotten; (3) number of synonyms employed; and (4) number of other substitutions. It should be said that the test of long sentences was conducted in a similar manner to that of short sentences, the only difference being in the reading. No effort was made to have the reading monotonous, but every word was given its normal emphasis and inflection.

5. *Memory of Sounds.* To make a detailed test for memory of sounds would have required an amount of time for preparation and for experiment which it was impracticable to give in this investigation. We were content, therefore, with propounding to the subjects certain questions in regard to the readiness and accuracy of their musical memory. They were as follows:

1. Can you carry an air at all?
2. Can you reproduce an air after hearing it once? In your head? By whistling or singing?

3. How accurate is this reproduction (if it has been tested)?

This test was applied both to the advanced students and to the juniors.

II. *Mental Images.*

1. *Letter Squares.* This test was one described and recommended by Mm. Binet and Henri. White cards were prepared, three by four inches in size, and divided by black lines into twelve equal squares, each square containing in its center a large printed letter. As the longer side of the card was taken as the horizontal, there were four letters on a horizontal line and three on a vertical. Ten different combinations of letters were chosen for these cards, to be used in ten different experiments. There were other cards, precisely similar to these, except that the small squares were left blank. The experiments were first conducted in this way. Each of the subjects had before him, on the desk or table, right side up, a card of blank squares, and also, face downward, a card containing the printed letters. The requirements of the experiment were explained to him. Upon the signal of the experimenter he should turn up the printed card, and learn the letters and their respective positions in the squares. Twenty seconds were to be given for this. At the second signal of the experimenter, the subject should turn down the printed card, and proceed immediately to reproduce the letters upon the blank cards in their proper places. The subject was further requested to write on the reverse of the (originally blank) card the nature of the

¹ A. Binet et V. Henri. *La mémoire des phrases.* *L'Année psychologique*, Vol. I, pp. 24 ff. See also *La psychologie individuelle*, *ibid.*, Vol. II. The same type of test was used likewise by Dr. Toulouse in the investigation mentioned in a previous footnote.

mental images from which the reproduction was made. Five of the experiments were made in this manner: in the remaining five a modification was made in regard to the time. The subject was allowed only five seconds between the first and second signals for studying the letters. There was then an interval of thirty seconds, before the experimenter gave a third signal to fill the blank cards. This had the effect of making the introspection of memory images more easy. It also increased the number of errors; and, as Mm. Binet and Henri make the usefulness of the test to depend principally upon the study of the nature of the errors made, this fact is of importance. Like-sounding letters may be substituted for the correct ones, thus indicating the presence of auditory images; or errors may be traced to a similarity in form of the letters substituted, etc. The letters in the printed squares were arranged in a variety of ways. The last letters in each horizontal line occasionally rhymed, and in rare cases consecutive letters formed syllables.¹

2. *Questions.* Under this heading may be placed the information gained from the writing on the reverse of the blank cards, mentioned above, as well as that obtained in questioning the subjects in connection with the tests for memory of words, letters and figures.

III. *Imagination.*

1. *Passive Imagination.* (a) Method of blots. This test is also one mentioned by Mm. Binet and Henri, and is similar to that used by Dr. Dearborn.² The blots were formed very much after the fashion described by the latter writer. A drop of ink was allowed to fall upon a small Bristol-board card, and a piece of paper was placed over the card and rubbed with the finger. In this way a variety of forms were made on different cards; ten cards, in all, being employed. This test was applied to the advanced students only. A card bearing a blot was handed to the subject, who was requested to name all the objects suggested by the form of the whole blot or of any part of it. He was allowed to turn the card about in any direction. The objects suggested were written down by the subject. Five minutes were allowed for this experiment. The number of objects seen in the blot, their kind, and the manner of reporting them, gave information in regard to the passive imagination of the individual tested.

(b) Associations with Abstract Terms. These experiments consist in interrogating the subject as to what he represents to himself when such words as 'force,' 'infinity,' 'justice,' etc., are said, and also as to his possession of number forms or visual schemes for the arrangement of months, seasons, etc.

2. *Constructive Imagination.* (a) Mechanical imagination. Two tests were used for this: a German toy called the "Magic Box," and a 'puzzle' watch. The magic box was a box of tin about 3 inches in diameter, through the center of whose lid projected the tip of a magnetized revolving rod, actuated through an internal mechanism of gears and fly wheel by a thrust on an arm projecting through the side of the box. A small triangular piece of tin with rounded corners, to which could be attached paper dolls or animals, would, of course, if put upon the cover of the box near the rod, be drawn around as the magnetized pivot revolved. This toy was shown to the subjects, as well as the method of starting the motion by pushing the projecting

¹ One set of letters was taken from the example given by Mm. Binet and Henri. Three others were copied from those used by Dr. Toulouse. Certain errors on the part of the printer made slight changes in these latter, however.

² G. Dearborn. *Psychological Review*, May, 1897, pp. 309 ff. Cf. the same author, *A Study of Imagination*. *Am. Jour. of Psychology*, Vol. IX, pp. 183 ff.

arm; but they were requested not to handle the toy. The requirement made of the subjects was to explain the mechanism causing the movement of the tin standard around the cover of the box. The two points in the explanation should have been (1) the magnetic connection between the revolving rod and the tin standard, and (2) the particular internal mechanism by which the revolution was initiated and maintained.

In the puzzle watch the works were confined within a small crescent-shaped portion of the cylindrical space, while the rest of the watch, except the nickel rim, was completely transparent, having glass faces front and back. All that could be seen in looking through this portion was the hands, the rod on which they were carried, and the gilt numerals on the glass dial-plate. There was, therefore, no visible mechanical connection between the hands and the works. The subjects were required to explain the movement of the hands. This was caused by the revolution of an inner glass plate held in a toothed metal ring. Both in this experiment and in the one above the subjects were given five minutes for a written explanation, but an extension of time was granted if desired. These tests were carried out with the advanced students only.

(b) Literary Imagination. Three kinds of experiments came under this head: (a) the construction of sentences, (b) the development of a given theme, and (c) the choice of a topic for composition. The construction test was performed in this way: Three substantives or three verbs were read to the subject, and he was required to write in five minutes as many and as varied sentences as possible, embodying in each the three words given. Ten experiments with substantives, and ten with verbs were tried with each of the advanced students. The same number of experiments was given to the Juniors, but there was a modification in the time requirement,—only two minutes instead of five minutes being allowed for the composition of the sentences. In order, however, to have results directly comparable with those obtained from the advanced students, two tests with substantives and two with verbs were also given to the Juniors, in which five minutes were allowed for the composition of the sentences. In each case the number and quality of the sentences were noted. For the next test, that of the developing of a theme, two sets of topics were chosen, one set for narration or description, and the other for exposition. Ten minutes were given for writing. Three topics for narration (or description) and three for exposition were given to all¹ the advanced students. The third test consisted in naming ten titles for essays, five coming under each of the above named classes, and requiring the subject taking the experiment to choose from the ten given the five upon which he would prefer to write papers, provided that such writing were demanded of him. The topics given for test (b), development of a theme, were the following: (1) For imaginative treatment: "Capture of a Fortress," "The Escape of a Prisoner," and "A Forest Fire." (2) For exposition: "The Delays of Justice," "The Influence of Newspapers," and "The Mission of Music." The topics given for test (c), choice of titles, were these: "In a Snowstorm," "A Polar Landscape," "A Puritan Sabbath," "My Opposite Neighbor," "Man Endowed with the Power of Flight," "Civilization not Regeneration," "Wisdom in Charity," "Friendship of Books," "Fiction as a Vehicle of Truth," and "The Eloquence of the Bar and that of the Pulpit." A sort of modification of the last two tests was given to the Juniors. On two occasions they were granted a choice between two titles (one of each type), from which they should sketch out a plan for an essay. The

¹ With the exception that W. M. failed to take one of the topics for exposition.

time allowed for this was five minutes. The topics submitted on the first occasion were: "The Capture of a Fortress" and "The Friendship of Books;" on the second occasion, "The Escape of a Prisoner" and "The Influence of Newspapers." The length of the written compositions, their manner of development, the kind of topic chosen, and the character of the plans made for them, are sources of information as to the imaginative type of the individual. Further information was sought by general questions in regard to individual tastes and tendencies, such as the favorite reading of the subject, his fondness for reflective games, the theater, opera, etc.

IV. *Attention.*

1. The *degree* of attention habitually exercised by an individual was measured by the quickness and accuracy with which a certain given task was performed. The task chosen for this purpose was the cancellation of every letter *a* from the words of a printed page. In order that the operation might not become too mechanical, the subject was sometimes requested to cancel the letter *e* instead. Proof pages (12 mo.) of the English translation of Külpe's "Introduction to Philosophy" were used for the cancellation, the pages averaging about 350 words. At a signal from the experimenter the subject began reading to himself at a normal rate, crossing every *a* as it came to his notice, but never going back to cancel those overlooked when they were first passed over. As soon as the page was finished the subject gave a signal. The experimenter was thus enabled to read from the stopwatch the time required for the cancellation. The number of errors was afterward determined. Eight pages were thus submitted to each of the advanced subjects for experiment; but, as the subject matter was a possible means of distraction from the work of crossing out *a*'s, other printed pages of a different character were also used. One page of concrete description (376 words) was prepared and printed without the use of punctuation, spacing or capitals. Another page of philosophical matter (340 words), a page of disconnected words, and a page of 'pied' matter, were printed in the same manner. Copies of these pages were used for experiments in the same way as those described above. In the Külpe proof all the subjects had different pages, while in the other tests the copies were exactly similar for each kind of page. In the latter case, therefore, results from the different subjects were immediately comparable, since no complication could arise from difference of subject matter. All the subjects cancelled the *a*'s from eight pages of proof, one page of concrete matter, one page of abstract matter, two pages of disconnected sentences and one page of 'pied' matter.

A further experiment upon the degree of attention was tried with the seven advanced subjects by requiring them to read aloud, first, a page of concrete description, printed without punctuation, capitals or spacing; and, secondly, a similar page of exposition of abstract thought. The time necessary for each reading was noted, as well as the correctness of the words and expression. The first page consisted of a description of the situation and equipment of a blockhouse upon a densely wooded island. The most notable feature of this page was the frequent occurrence of monosyllabic words; while that of the second or abstract page consisted in the repetition of certain words, such as 'subject,' 'object,' 'relation,' 'absolute,' 'power,' 'force,' etc. The first page was slightly longer than the second, the number of words being 376 and 340 respectively.

2. *Range of Attention.* To test the subjects in regard to range of attention, a single experiment was tried in conformity with that sug-

gested by Mm. Binet and Henri. The subject was required to read aloud with normal rapidity and expression a passage of ten lines from a contemporary novel. The time taken by this reading was noted. The subject was then requested to read the same passage in precisely the same way as before, but while doing so to write on a sheet of paper beneath his hand the letter *a* as many times as possible. Again, the subject was requested to reread the passage, this time writing *a b* repeatedly. During a fourth reading, *a b c* were the letters required to be written. A fifth and last reading was then requested, during which the subject should write as far down the alphabet as he could without altering his reading; while if the alphabet were completed and time still remained, he should begin again at *a* and write as before. The chief difficulty in this experiment was in maintaining a uniform rate in the reading throughout the five tests, for the tendency in almost every case was to lengthen the reading in those tests which involved the simultaneous writing of letters, thus allowing time for a rapid oscillation of the attention from one set of acts to the other, and destroying their simultaneity. Where success was attained, however, in keeping the reading unchanged, the number of letters of the alphabet written by the subjects gave information in regard to individual differences in ability to perform practically simultaneous acts and thus in range of the attention; while in the cases where there was a decided lengthening of the reading during the performance of writing, this very fact was an indication of lack of such ability.

V. Observation; Discrimination.

This corresponds to the heading termed by Mm. Binet and Henri the 'faculty of comprehending,' and comprises phenomena known under various names, such as *talent of observation*, *keenness of mind*, *good sense*, *judgment*, etc., owing to the difficulty of precise definition. By it is meant the power to perceive relations, to distinguish the real and essential from the apparent and accessory; the ability to analyze and systematize. The lack of analysis of the processes involved makes exact investigation impossible, but certain tests have been adopted which are calculated to throw light upon the individual differences in this aspect of mind. Of these tests, the first two—those which have especially to do with observation—may be classed also as tests of memory; but since the memory is immediate, while the time of observation is very short, the individual differences seem to be attributable to the latter rather than to the former. The first test was applied after this manner. The reproduction of a picture, cut from a magazine, with the title carefully trimmed off, was shown to the subject for a period of thirty seconds, after which he was requested to write out a full description of what he saw, five minutes being allowed for the writing. This experiment was tried upon all the advanced students with two different pictures. The first picture, entitled the "Golden Wedding," was more satisfactory than the second, "An Interrupted Duel," in that it contained far more variety of detail, more unmistakable feeling, and somewhat greater scope for difference of interpretation. Both pictures, however, contained more detail than could be exhausted by an attentive observation of thirty seconds. This test is very similar to that described by M. Binet in his article *La description d'un objet*,¹ the chief difference being that the picture—in this case exposed to the observation of children—represented a scene from a familiar fable, and the subjects were so informed before looking at it. The time of observation was two minutes, instead of thirty seconds.

¹ L'Année psychologique. Vol. III, pp. 296 ff.

The results from this test, as from those of imagination, seem to be mainly valuable as indicating certain individual types.

The second test under Observation is similar to the first and may be briefly dismissed as having in itself small value. A small colored card, representing a lady rather brilliantly dressed standing before a dressing table upon which reposed variously tinted bottles and boxes, was shown to the subject for the space of five seconds, after which he was requested to write down all the different colors he had observed on the card, together with the location of each. This test, like the first, may be reckoned one of observation rather than of memory, since the colors of the pictured card were not that to which attention would naturally be primarily directed; moreover, the colors were few and could easily be remembered if noticed. Hence the number of colors actually remembered was an indication of the degree in which they attracted the attention of the observer. Since, however, the experiment was given but once, the result could not be taken as showing a permanent attitude of mind.

The third test departed entirely from the sphere of sensible perception, and had to do with thought relations. A pair of synonyms was given to a subject, and he was allowed five minutes for writing down the distinction between the words in regard to their meaning and use. Six pairs of such words were given to the Junior class and seventeen to the advanced students.

VI. *Taste and Tendencies.*

Under this heading are grouped the remaining experiments, the object of which was to test in the several individuals the appreciation of the beautiful as expressed especially in art, music, and literature. In these tests the assumption is made that the taste for an art will carry along with it a knowledge of that which is universally conceded to be the best work in that sphere, as well as some knowledge of the authors of it. This seems to be a warrantable assumption, if we take into consideration the individuals tested; since all must have had opportunities (college libraries, magazines, etc.) to learn of that toward which their natural tastes directed them. Art, music, and literature form the basis for the investigation; art being taken in the restricted sense as comprising painting and sculpture.

1. *Art.* Three tests belong here. (a) For this test, a selection of twelve paintings was made from among those which are given the very highest place in that art. Photographic reproductions of these were used. A subject was given a photograph, and allowed five minutes for noting in writing five things: title, artist, school, and approximate date of the original, together with a brief description from the photograph itself. The paintings chosen were these: Raphael's *Sistine Madonna*, Michael Angelo's *Last Judgment*, Leonardo da Vinci's *Last Supper*, Rubens' *Descent from the Cross*, Correggio's *Holy Night*, Titian's *Assumption of the Virgin*, Murillo's *Immaculate Conception*, Rembrandt's *Night Watch*, Volterra's *Descent from the Cross*, Guido Reni's *Beatrice Cenci*, Velasquez' *Portrait of Himself*, and Guido Reni's *Aurora*. These photographs were given not only to the advanced subjects, but also to the members of the Junior class. As there was but one photograph of each painting, and as the time available was not sufficient to allow five minutes for considering each photograph, the experiment was performed upon the Juniors in this way. Each photograph was numbered upon the back, and all were distributed among the class, face downward. The experimenter then gave instructions, reading the questions (given above) to which answers should be written. A signal was then given: the subjects wrote

down at the head of a sheet of paper the number on the back of the photograph. Another signal, and the photographs were turned, and one full minute allowed for writing the answers. Then the photographs were passed on, from each student to the next, and the signals were repeated as before.

Tests (b) and (c), given to the advanced students only, consisted in allowing five minutes each for the subject to write (b) the names of as many noted pieces of sculpture as possible, and (c) the names of as many artists renowned in the sphere of painting or plastic art as could be written in the given time.

2. *Music.* Here the tests are similar in nature to those above. (a) The subject was required to name, on paper, as many musical composers of renown as possible in five minutes. (b) The subject, being given a list of ten musical composers, was required to name one composition or important class of composition produced by each. Five minutes was the allotted time for this also. The list of composers comprised the following: Mendelssohn, Beethoven, Chopin, Mozart, Wagner, Liszt, Schumann, Rubinstein, Handel, and Schubert. (c) The test previously described under the partial memory of sounds (power to remember and reproduce musical airs) has a bearing upon this part of our subject.

A modified form of these tests was given to the Juniors. They were required to write (1) a list of six musicians, (2) one production under each name, (3) the style of each, *i. e.*, his favorite form of composition, and (4) to answer the question: "What did Wagner introduce into Grand Opera?"

3. *Literature.* (a) Selections were chosen from eight prominent English prose writers, and read aloud to the subjects. After the reading of each, the subject wrote whom he considered to be the author of the selection, as well as the source of this judgment: whether memory of the particular passage, or inference drawn from the style or subject matter. The writers and selections were as follows: Macaulay, *The Progress of England*, from *Essays on Sir James Mackintosh*; Ruskin, *The Open Sky*, from *Modern Painters*; Bacon, *Of Studies*, from the *Essays*; Dickens, *Mrs. Gamp's Apartment*, from *Martin Chuzzlewit*; De Quincy, *A Wonderful Dream*, from *Confessions of an English Opium Eater*; Carlyle, *Labor*, from *Past and Present*; Thackeray, *Family Prayers*, from *The Newcomes*; and Scott, *Raleigh's First Interview with Queen Elizabeth*, from *Kenilworth*.

(b) Similar selections were chosen from eight English and American poets, and the test was performed in the same manner as the above. The subjects were informed that the poetry might be taken from either English or American writers. The passages selected were these: Wordsworth's *Ode to Immortality*, first two stanzas; Shakespeare's *Midsummer Night's Dream*, speech of Theseus on Imagination; Tennyson's *In Memoriam*, LIII; Milton's *Ode to His Blindness*; Browning's *Rabbi Ben Ezra*, stanza "Thou Fool!" etc.; Bryant's *To a Waterfowl*, last three stanzas; Holmes' *The Chambered Nautilus*, last two stanzas; and Spenser's *Fairy Queen* I, 4: 4, 5 (*The House of Pride*).

4. A further test of tastes and tendencies consisted in the questions put to the subjects as to the character of their favorite reading, their fondness for the opera, the play, and for reflective games such as whist, chess, etc. See above, under III.

§ 5. Results.

We have next to consider the results obtained from the tests that have been outlined. They may be considered from two

points of view, quantitatively and qualitatively. Some tests best lend themselves to a numerical expression of results, while the outcome of others must be estimated chiefly in terms of quality. Among the former are the tests of the first group, those upon memory.

I. *Memory.*

1 and 2. *Memory of letters and memory of figures.* These may be considered together, since the tests were closely similar and performed in the same manner.

TABLE I.

SUBJECTS.	MEMORY OF LETTERS.		MEMORY OF FIGURES.	
	Average times exposed.	Fluctuation limits.	Average times exposed.	Fluctuation limits.
B.	(2) 3	1—6	(3) 2.9	1—4
G.	(1) 2.25	1—4	(1) 2.25	1—3
V. M.	(7) 4.95	2—12	(6) 3.7	2—5
W. M.	(3) 3.2	2—5	(2) 2.6	2—4
E. R.	(5) 3.9	3—6	(5) 3.5	2—5
L. R.	(6) 3.95	2—7	(7) 4.55	3—9
T.	(4) 3.3	1—6	(4) 3	2—4

Table I gives for each individual (1) the averages, taken from twenty experiments each of letters and figures, of the times necessary to expose a series of twelve before it is correctly repeated, and (2) the fluctuation limits, that is, the highest and the lowest number of exposures required for the memorizing of one series by the different individuals. The small figures in brackets at the left of the first and third columns indicate the order of the averages from the lowest to the highest, or the order of the individuals in regard to rapidity of memorizing from the most to the least rapid.

A comparison of the results from the last five experiments with letter series with those from the first five makes evident the effect of practice. In the last experiments also, the individual differences decreased. In the figure series the effect of practice in the last experiments was less apparent. This was, no doubt, partly due to the fact that the practice gained in the memorizing of letters facilitated the memorizing of the figures from the first.

A glance at Table I will show a certain correspondence between the order of averages for letters and that for figures. Where changes have taken place, it is between those individuals whose averages were contiguous. Thus, 2 and 3, and 6 and 7 changed places, but there is no

indication of a strongly developed partial memory for either letters or figures alone, on the part of any individual, which would make a radical difference in the order of averages for the two kinds of experiments. The Table shows, in general, a slightly better memory for figures than for letters, with one marked exception (*L. R.*). Memory of figures might have been easier for several reasons. The practice mentioned above, gained from the similar memorizing of letters, the permanent practice gained in the course of education, and the fact that figures, in whatever order, make an intelligible combination, all would contribute to greater ease in learning figures. In the case that shows a decided divergence from this rule, the cause probably lies in the fact that the subject tried to rely upon her visual memory, and that, as there was necessarily a recurrence of some figures in a series of twelve, the repetition tended to fatigue the attention and confuse the mind of the subject in regard to the order of the characters. The decrease in the variety of form doubtless made the figure series harder to remember than the letters. The Table shows not only a lowering in the averages for memory of figures, but a lowering, in the case of every individual but the one above excepted, of the upper limit of fluctuation.

The mode of memorizing the letters and figures used by the subjects, as learned from observing them and also from their own reports, shows no coincidence between any particular memory type and any special ability or disability for memorizing.

3. *Memory of words.*

TABLE II.

SUBJECTS.	B.	G.	V. M.	W. M.	E. R.	L. R.	T.
Av. per cent. of words reproduced in short series.	(5) 81.1	(2) 84.2	(3) 84.1	(6) 77.5	(7) 75.6	(4) 82.2	(1) 98.5
Av. per cent. of words reproduced in recapitulation.	(2) 34.6	(1) 54.3	(5) 27.9	(3) 34.1	(7) 19.0	(6) 27.5	(4) 29.6
Difference.	(3) 46.5	(1) 29.9	(5) 56.2	(2) 43.4	(6) 56.6	(4) 54.7	(7) 68.9

Table II gives on its first line the average percentage of words of short series which were immediately repeated by the subject after the series was read to him. The percentages represent for each individual the results obtained from four sets of seven short series each. The second line of the Table gives the average number of words mentioned

by each subject in recapitulating from memory as many as possible of the whole forty-nine words contained in a set of seven series of seven words each. The averages in this line were also made from four sets of such series. The third line of the Table gives the average percentage of loss sustained by the memory in the time intervening between the repetition of the short series and the recapitulation. The first line, then, indicates individual differences in the immediate memory of verbal sounds; the second line, individual differences in the memory of conservation; and the last line, individual differences in loss.

The words used in these tests were of varied character, comprising names of particular objects, qualities, virtues, general and abstract terms, in wholly disconnected order. The results showed no marked individual differences in the kind of words remembered. A fair proportion of the abstract terms were remembered by all the subjects. In general, the position of the words in the original series gave no clue to individual differences in the recapitulations. The words in the first and last parts of the sets were usually those best represented in the recapitulations of all the subjects. In the case of *T.*, however, the tendency to remember best the words in the last short series was more marked than in the others.

Table II shows in the first line an order among the individuals quite different from that observed in the previous Table. *T.*, who there held the fourth place, here stands far higher than any other; and *V. M.* and *L. R.* change from the sixth and seventh to the third and fourth places. This change is largely due to the fact that the remembered stimuli are auditory instead of visual. In the short series it was chiefly a succession of sounds that was remembered, as is attested by the fact that, where mistakes by substitution occurred, they were almost invariably of like-sounding words, such as *flower* for *floor*, or *furnish* for *furnace*; while, in the recapitulation, the errors are usually additional words suggested from analogy of sense, such as *dog* suggested by *cat*, *cold* by *winter*, and *accident* by *horror*. In the recapitulation, the order among the individuals returns very nearly to what it was in the first two tests.

4. *Memory of Sentences.* (a) *Memory of Short Sentences.*

Table III gives under four headings the average percentages obtained from twenty sentences under each of the five groups. The sentences increase in abstractness from Group I to Group V. The average length of sentences under each group is given at the foot of the Table. The exact meaning of the four headings under which the percentages are classified has been before stated. The complete results from which these averages are drawn show for a single subject, in a single group of similar sentences (similar in regard to abstractness), fluctuations larger than the differences in the averages of widely separated groups. This is evidence of the complexity of the factors which enter into these experiments. The differences in the length of the sentences (though these are not large), the differences in construction, the use of words

TABLE III.

	GROUP I.				GROUP II.				GROUP III.				GROUP IV.				GROUP V.			
	AVERAGE PERCENTAGES.				AVERAGE PERCENTAGES.				AVERAGE PERCENTAGES.				AVERAGE PERCENTAGES.				AVERAGE PERCENTAGES.			
	Verbal Accuracy.	Order.	Sense.	Certainty.	Verbal Accuracy.	Order.	Sense.	Certainty.	Verbal Accuracy.	Order.	Sense.	Certainty.	Verbal Accuracy.	Order.	Sense.	Certainty.	Verbal Accuracy.	Order.	Sense.	Certainty.
B.	84.9	98.8	88.6	94.5	80.5	98.9	95.3	91.0	78.7	99.1	85.7	90.2	74.4	97.6	87.1	88.7	73.5	96.2	83.7	89.0
G.	93.5	99.0	96.4	98.3	94.5	99.6	99.6	97.5	88.3	99.8	97.0	98.2	87.3	98.4	95.8	97.1	92.1	98.8	99.4	97.4
V. M.	88.1	99.0	94.5	98.4	94.3	99.5	97.8	98.5	90.7	99.4	96.1	97.4	87.2	99.4	94.6	98.6	82.0	97.1	88.1	94.2
W. M.	84.5	98.4	90.6	97.8	87.8	98.9	90.4	97.5	85.3	98.6	86.8	96.5	83.6	99.3	92.2	96.5	79.4	98.4	86.8	97.6
E. R.	76.9	98.2	84.2	97.3	85.3	97.5	83.3	95.5	69.6	97.9	83.2	85.3	82.0	98.1	85.3	82.3	70.9	97.9	83.4	88.7
L. R.	88.4	98.6	93.5	95.5	89.5	99.7	97.5	96.8	84.6	99.2	91.5	93.8	73.2	98.3	93.8	94.0	81.3	98.4	81.2	92.6
T.	96.5	100.0	97.3	99.1	97.5	100.0	97.7	98.7	94.7	100.0	92.7	99.3	95.0	99.6	98.8	97.7	94.5	99.0	95.4	97.5
	Av. length of sentences = 24½ words.				Av. length of sentences = 23½ words.				Av. length of sentences = 25½ words.				Av. length of sentences = 24½ words.				Av. length of sentences = 24½ words.			

which may chance to be somewhat unfamiliar to the subject, and, perhaps, more important than all, the varying subjective conditions under which the experiments are performed, produce results of more varying character than those which come from differences in the abstractness of the sentences. One page from the original results, chosen at random, will show the lack of constancy in the averages under any one group of sentences.

Specimen Page of Original Results.

SUBJECT B.

Sentences.	% Verbal Accu- racy.	% Order.	% Sense.	% Cer- tainty.	Sentences.	% Verbal Accu- racy.	% Order.	% Sense.	% Cer- tainty.
1, III, 22	100.0	95.5	100.0	93.2	1, IV, 22	100.0	100.0	100.0	93.2
2, III, 23	83.1	100.0	69.6	93.5	2, IV, 22	77.3	100.0	86.4	95.5
3, III, 23	95.7	100.0	100.0	91.4	3, IV, 23	95.7	100.0	100.0	100.0
4, III, 24	87.5	100.0	95.9	95.9	4, IV, 23	95.7	100.0	100.0	97.9
5, III, 24	95.9	100.0	100.0	93.8	5, IV, 23	100.0	100.0	100.0	95.7
6, III, 24	62.9	100.0	75.0	100.0	6, IV, 23	67.4	95.7	91.4	93.5
7, III, 24	95.9	100.0	100.0	98.0	7, IV, 24	83.4	95.9	87.5	98.0
8, III, 25	50.0	100.0	78.3	96.0	8, IV, 24	83.4	100.0	83.4	93.8
9, III, 25	86.0	100.0	100.0	93.5	9, IV, 24	83.4	95.9	87.5	95.9
10, III, 25	84.0	100.0	84.0	98.0	10, IV, 25	40.0	92.0	72.0	74.0
11, III, 25	86.0	96.0	92.0	76.0	11, IV, 25	56.0	96.0	76.0	92.0
12, III, 25	80.0	100.0	100.0	90.0	12, IV, 25	56.0	92.0	56.0	76.0
13, III, 25	76.0	100.0	88.0	90.0	13, IV, 25	96.0	100.0	100.0	90.0
14, III, 26	79.3	100.0	100.0	84.7	14, IV, 25	92.0	100.0	92.0	96.0
15, III, 26	96.6	100.0	100.0	94.3	15, IV, 25	80.0	96.0	92.0	92.0
16, III, 26	80.8	100.0	84.7	98.1	16, IV, 25	77.0	96.6	100.0	100.0
17, III, 27	70.4	100.0	100.0	100.0	17, IV, 26	88.5	100.0	96.1	96.1
18, III, 28	82.2	96.5	96.5	92.9	18, IV, 26	61.6	100.0	96.1	94.3
19, III, 28	89.3	100.0	100.0	94.7	19, IV, 27	77.8	96.3	100.0	88.9
20, III, 28	92.9	100.0	100.0	100.0	20, IV, 28	57.2	96.5	85.8	91.2
Average	78.7	99.1	85.7	90.2		74.4	97.6	87.1	88.7

The results from sentences given to the Juniors show precisely the same characteristics, and hence will not be given here.

Table III shows that the columns headed *order* of words and degree of *certainty* of the subject indicate small differences between the individuals in these respects, although in the groups of the more abstract sentences individual differences in regard to the certainty of memory increase. Again, slighter individual differences are seen in *sense* than in *verbal accuracy*, the former being very frequently preserved when the latter is at fault. Considering, then, the verbal accuracy alone, we find, except in the case of one subject, that there is no constant lowering of the percentages as the sentences become more abstract. Between contiguous groups of sentences, where differences in concreteness or abstractness are slight, the length of the sentences appears to have a

decided influence. For example, all subjects but one (*B.*) have a higher percentage of verbal accuracy for Group II, which averages shorter sentences, than for Group I; while in Group III, whose sentences average longer than those of Group I, there is a lowering of the percentages for verbal accuracy on the part of each subject. A just comparison of the individual differences in the different groups should, however, take into consideration all of the four headings for marking. It may be made from Table IV, which gives the averages of the four percentages for each individual under each group, as well as the general average from all the percentages of all the sentences.

TABLE IV.

	I	II	III	IV	V	General.
	%	%	%	%	%	%
B.	⁶ 91.7	⁶ 91.4	⁵ 90.9	⁶ 86.9	⁶ 85.6	⁶ 89.2
G.	² 96.8	² 97.8	³ 95.8	³ 94.7	¹ 96.7	² 96.4
V. M.	³ 95.0	³ 97.5	² 95.9	² 94.9	⁴ 90.4	³ 94.7
W. M.	⁵ 92.8	⁵ 93.7	⁶ 90.6	⁴ 92.9	³ 90.5	⁵ 92.1
E. R.	⁷ 89.1	⁷ 90.4	⁷ 84.0	⁶ 86.9	⁷ 85.2	⁷ 87.1
L. R.	⁴ 94.0	⁴ 95.9	⁴ 92.3	⁵ 89.8	⁵ 88.4	⁴ 92.0
T.	¹ 98.2	¹ 98.5	¹ 96.7	¹ 97.7	² 96.6	¹ 97.5

In Table IV several things may be noted. Every individual (except *B.*, whose I and II figures are practically equal,) attained his highest percentage in Group II, that which averages the shortest sentences. The position of the lowest percentages varies with the individuals. For *T.* and *W. M.*, this percentage is practically the same in Group III, which averages the longest sentences, and in Group V, which contains the most abstract sentences: a slight difference in lowness being in favor of the latter. For *E. R.* the percentage shows that it is Group III which is most difficult, while for *B.*, *V. M.*, and *L. R.*, it is Group V. The remaining subject, *G.*, has her lowest average, strange to say, in Group IV, which is intermediate both as to length and abstractness between III and V. For all subjects, however, the percentage in Group V is lower than in Group I, the amount of the difference varying in the individuals as follows: *B.*, 6.1%; *G.*, 0.1%; *V. M.*, 4.6%; *W. M.*, 1.3%; *E. R.*, 3.9%; *L. R.*, 5.6%; and *T.*, 1.6%.

In regard to the order in which the individuals stand in the different groups, as indicated by the small figures in the Table, it will be seen that no subject keeps the same order throughout. *T.* shows the greatest constancy. The subjects may, however, be grouped in a general way. *T.*, *G.*, and *V. M.* hold the first three places; *W. M.* and *L. R.* connect, and *B.* and *E. R.* last. This grouping agrees, too, with the order of results in the general averages.

If the order seen in the last column of Table IV be compared with that observed in Tables I and II,—that is, the order of the subjects in regard to memory of letters, figures, and words,—it will be found that the former approaches most nearly the order in the immediate memory for words. In the test of sentences, as in that of words, the stimuli were auditory impressions, to be reproduced immediately after dictation. In the case of sentences, however, the sense of the words had much more influence; for although the words were read by the experimenter very monotonously, as if they formed an unconnected list, and the interpretation was left to the subject, yet this, when made, could not but prove a material aid to the memory. For both these reasons the order is very different from that observed in the memory for letters and for figures, while only slightly different from that for the immediate memory for words.

Considering the test in general, it may be said that, in sentences of the length here used, abstract sentences are very little more difficult than concrete for any of the subjects (including the Juniors). Moreover, in regard to the availability of the test, the results shown are of too meager and indecisive a character to be at all in proportion to the time and labor necessary for the selection, classification and correction of the sentences.

(b) Memory of Long Sentences.

Table V gives in full the results, for the advanced students only, of the test of long sentences, where two sentences are given for each of the five degrees of abstractness. A word should be said in regard to the categories under which the marking is made. The number of words forgotten means only those which have entirely dropped out from the memory, those for which no substitution, even though inaccurate, is made. The number of groups retained embraces only those in which there is absolutely no change in verbal form. The 'number of synonyms' means the number of words in the original passage for which synonymous words or phrases are substituted. These substitutions may have a more contracted or expanded form than the original, but contractions are by far the more numerous. The fourth category, 'number of substitutions,' means the number of words in the original passage which are represented in the reproduction, but not with sufficient accuracy to be classed as synonymous substitutions, *plus* the words in the reproductions which have no counterparts in the original passage. Substituted forms may be words which mean something different from the original, although related to it by analogy; or they

may be whole sentences or parts of sentences which express fairly well the main idea of the original, while ignoring all minor points of significance, and with an entire change of syntax and verbal form; or, again, they may consist in the addition of words not found in the

TABLE V.

	A I, 52 words, 23 groups.						A II, 58 words, 15 groups.						A III, 64 words, 23 groups.						A IV, 52 words, 15 groups.						A V, 51 words, 21 groups.								
	No. of words forgotten.	No. of groups retained.	Synonyms.	No. of Substitutions.	No. of words forgotten.	No. of groups retained.	Synonyms.	No. of Substitutions.	No. of words forgotten.	No. of groups retained.	Synonyms.	No. of Substitutions.	No. of words forgotten.	No. of groups retained.	Synonyms.	No. of Substitutions.	No. of words forgotten.	No. of groups retained.	Synonyms.	No. of Substitutions.	No. of words forgotten.	No. of groups retained.	Synonyms.	No. of Substitutions.	No. of words forgotten.	No. of groups retained.	Synonyms.	No. of Substitutions.					
B.	15	12	0	12	21	7	0	6	25	2	0	22	21	3	0	14	17	2	15	7	46	2	2	15	7	46	2	2	15	7			
G.	0	22	4	4	1	14	0	0	4	18	3	1	1	10	5	3	3	3	0	5	3	46	2	0	0	3	46	2	0	0	6		
V. M.	8	16	5	2	8	3	14	4	16	8	11	11	23	3	3	11	17	3	11	3	17	3	5	1	39	3	5	1	39	3	5	20	
W. M.	4	15	1	11	20	5	4	1	12	5	23	5	29	6	1	10	23	4	3	5	29	6	1	10	23	4	3	5	20	23	4	3	23
E. R.	13	16	2	6	10	1	3	32	12	1	3	40	8	5	7	2	2	14	3	3	14	3	3	3	14	3	3	3	3	14	3	3	16
L. R.	10	15	6	1	10	4	3	7	17	1	1	25	10	8	1	4	10	8	1	4	10	8	6	2	16	10	8	6	2	16	10	8	16
T.	24	12	1	0	9	12	1	0	12	9	0	11	10	9	0	11	10	8	1	4	10	8	5	1	4	10	8	5	1	4	10	8	16

	B I, 55 words, 24 groups.						B II, 57 words, 17 groups.						B III, 63 words, 24 groups.						B IV, 59 words, 21 groups.						B V, 59 words, 21 groups.									
	No. of words forgotten.	No. of groups retained.	Synonyms.	No. of Substitutions.	No. of words forgotten.	No. of groups retained.	Synonyms.	No. of Substitutions.	No. of words forgotten.	No. of groups retained.	Synonyms.	No. of Substitutions.	No. of words forgotten.	No. of groups retained.	Synonyms.	No. of Substitutions.	No. of words forgotten.	No. of groups retained.	Synonyms.	No. of Substitutions.	No. of words forgotten.	No. of groups retained.	Synonyms.	No. of Substitutions.	No. of words forgotten.	No. of groups retained.	Synonyms.	No. of Substitutions.	No. of words forgotten.	No. of groups retained.	Synonyms.	No. of Substitutions.		
B.	16	10	4	7	10	8	4	10	30	10	2	4	7	10	10	1	11	4	6	7	26	4	6	7	28	26	4	6	7	28	26	4	6	
G.	2	22	3	2	1	12	5	3	1	15	12	3	3	7	12	3	5	3	26	7	26	7	1	5	3	26	7	1	5	3	26	7	1	5
V. M.	7	19	7	2	9	11	3	0	19	6	4	6	9	11	5	6	20	9	11	5	32	5	5	13	14	32	5	5	13	14	32	5	5	
W. M.	21	10	0	3	9	12	1	2	15	9	5	5	11	11	2	0	18	0	1	11	22	5	13	1	36	22	5	13	1	36	22	5	13	
E. R.	16	13	3	3	9	4	3	26	8	3	8	11	20	11	2	0	18	0	1	11	15	4	12	1	36	15	4	12	1	36	15	4	12	
L. R.	8	17	7	5	7	11	2	1	38	10	5	6	21	4	10	1	11	0	1	10	15	4	12	1	36	15	4	12	1	36	15	4	12	
T.	6	20	3	1	3	9	4	3	25	6	5	6	7	10	7	1	11	7	1	10	0	2	10	26	0	15	2	10	26	0	15	2	10	
Totals	150	219	46	59	124	113	47	95	229	102	87	169	171	88	38	136	254	51	86	188	254	51	86	188	254	51	86	188	254	51	86	188		

original. The latter kind is not of frequent occurrence. It will be seen that the Table does not represent the results precisely. It gives the number of words *for* which substitutions are made, but not the

number of words substituted ; neither does it tell just *how* closely the latter conform to the former in meaning. The four categories employed seem, however, to be those most practicable for marking the sentences employed in this test.

Table V shows that here, as in the preceding test, there is a considerable lack of constancy in the results. The memory of long sentences requires a high degree of attention on the part of the subject, and any accidental subjective condition which may serve to distract him will produce an effect on the results which no consideration of the objective conditions can account for. The same individuals show often a wide discrepancy of results between two sentences of the same degree of abstractness and of almost the same length and number of words. The totals, however, show here, as in the test with short sentences, that the most abstract sentences are more difficult to remember than the concrete. The total number of groups retained steadily decreases from I to V. The total number of words completely forgotten is considerably greater in V than in I, although in length the sentences do not greatly differ. In III, where the sentences are long, the number of words forgotten is almost as great as in V ; a result which also agrees well with that observed in the previous experiment. In general, the number of synonyms increases as the sentences become more abstract, and the number of substitutions increases in even larger proportion.

TABLE VI.

	Number of words forgotten in all the sentences	Number of groups retained in all the sen- tences.	Number of syn- onyms in all the sentences.	Number of sub- stitutions in all the sentences.
B.	6. 166	6. 70	6. 33	2. 121
G.	1. 89	1. 184	5. 36	7. 26
V. M.	5. 148	3. 79	1. 60	5. 66
W. M.	7. 179	4. 78	3. 58	6. 49
E. R.	4. 124	7. 45	4. 40	1. 224
L. R.	3. 118	5. 78	2. 59	3. 94
T.	2. 104	2. 93	7. 28	4. 78

Table VI shows a summary of results. It gives for each subject the total number of words forgotten, groups retained, etc. Individual characteristics here manifest themselves. For *B.* this characteristic is the large number of words completely forgotten, for *G.* the large number of groups accurately remembered, for *E. R.* the large number of substitutions ; while for the remaining subjects the number of words completely forgotten seems the most prominent characteristic.

Several things are to be noted in regard to the order as indicated by the small figures. The order in the number of groups retained is the same as in the general averages for memory of sentences, with the exception that *T.* and *G.* have changed their places as 1 and 2 respectively. It has been seen that *T.* excelled when immediate auditory memory was called into play. Here the sentences are so much longer than the preceding ones that the auditory memory has been forced into greater subservience to the memory of ideas, and hence the loss of rank follows. That the order in columns 1 and 2 differs considerably arises from the fact that, where groups are not exactly retained, they need not all be dropped out, but may be expressed, with more or less exactness, in a different verbal form. It is to be noticed, also, that the order in column 4 and that in column 2 are almost precisely reversed; that is, those who have retained the greatest number of groups have employed the least number of substitutions, and *vice versa*. All this throws some light upon the relative reliability of the memory in the subjects tested. *G.* shows not only the largest number of groups retained and smallest number of forgotten words, but also a preponderance of synonymous words over substitutions. *W. M.*, whose number of forgotten words is large, has also a preponderance of synonyms over substitutions. In all other cases the substitutions outnumber the synonyms. This is markedly the case for *E. R.*; *B.* shows the same characteristic in a lesser, but still large, degree. Both kinds of changes in expression result from what Mm. Binet and Henri call 'verbal assimilation.' The subject gives to a passage, as it enters his mind, the stamp of his own personality, imparts to it his own habits of thought.

5. *Memory of Musical Sounds.*

The responses to the three questions: (1) Can you carry an air at all? (2) Can you reproduce an air after hearing it once? In your head? By whistling or singing? and (3) How accurate is your reproduction (if it has been tested)?—have been tabulated for the advanced students as follows.

TABLE VII.

	Carry Air?	Reproduce after single audition.		Accurate?
		Mentally?	Physically?	
B.	Yes.	Seldom.	No.	Not tested.
G.	Yes.	No.	No.	Only after learning.
V. M.	Yes.	Often.	Partially.	{ Mental reproduction accurate. Physical, not.
W. M.	Yes.	Partially.	Partially.	Fairly accurate.
E. R.	Yes.	Yes.	Sometimes.	Not tested.
L. R.	Yes.	Partially.	Partially.	Yes.
T.	Yes.	Partially.	Partially.	Yes.

The memory for musical sounds cannot be compared with that for letters, figures, etc., since no direct test was given for the former. The answers above tabulated are, moreover, not sufficiently precise to warrant any exact comparison between the individuals in regard to the readiness and accuracy of their musical memory. All that can be said is that *B.* and *G.* appear to fall within a different group from the other subjects. That musical memory is something quite distinct from mere auditory imaging is shown by a comparison of *G.*'s line in this Table with the corresponding line in Table VIII.

II. *Mental Images.*

Letter Squares.—In this test the errors made are intended to form the basis of a judgment in regard to the kind of mental images employed by the subjects in their reproduction of printed letters. The largest error, however, lay throughout in incompleteness; that is, the omissions far outnumbered the actual mistakes. Again: the number of right letters placed in the wrong squares exceeded greatly the number of wrong letters, *i. e.*, of letters which did not appear on the printed card at all. The omissions are, for the most part, non-committal as regards mental images; the errors of position are often equally so; while the wrong letters used do not invariably make the kind of images a matter free from doubt. The subject's report of introspection, therefore, which accompanied each experiment, is of great value, and, when considered along with the errors made, may be taken as giving reliable information. A summary of the information thus gained may be given as follows.

TABLE VIII.

- B.* Visual images most prominent, *motor* next, and *auditory* least.
- G.* Auditory and *motor* images prominent, *visual* very slight.
- V. M.* Visual very prominent, *motor* next, and *auditory* least.
- W. M.* Visual very prominent, *auditory* and *motor* both important.
- E. R.* Motor most prominent, *auditory* next, *visual* rarely present.
- L. R.* Motor and *auditory* prominent, *visual* slight.
- T.* Auditory and *motor* images prominent, *visual* slight.

One of the most noticeable characteristics shown by the introspective reports is that, in the case of one subject (*L. R.*), the letters were rarely remembered directly, but usually through a verbal association formed at the sight of the printed card, this verbal association being in tactual and auditory terms. Other subjects sometimes used verbal associations to aid the memory, but to a much less extent. The indirect method was, however, common among the Juniors. The answers obtained from questioning the subjects in connection with the tests for memory of words, letters, and figures, confirm the conclusions in the above summary. Beside these questions each subject was requested to state where, in his opinion, he should be placed under the degrees of mental imagery (visual imagery) as classified by Francis

Galton in his *Inquiries into Human Faculty*, p. 93. This classification was made from responses received from a large number of individuals questioned in regard to the illumination, definition, and coloring of their mental images. The classification is in full as follows:

Degrees of Mental Imagery. Highest.—Brilliant, distinct, never blotchy.

First Suboctile. The image once seen is perfectly clear and bright.

First Octile. I can see my breakfast table or any equally familiar thing with my mind's eye quite as well in all particulars as I can do if the reality is before me.

First Quartile. Fairly clear; illumination of actual scene is fairly represented. Well defined. Parts do not obtrude themselves, but attention has to be directed to different points in succession to call up the whole.

Middlemost. Fairly clear. Brightness probably at least from one-half to two-thirds of the original. Definition varies much, one or two objects being much more distinct than the others, but the latter come out clearly if attention be paid to them.

Last Quartile. Dim, certainly not comparable to the actual scene. I have to think separately of the several things on the table to bring them clearly before the mind's eye, and when I think of some things the others fade away in confusion.

Last Octile. Dim, and not comparable in brightness to the real scene. Badly defined, with blotches of light; very incomplete; very little of an object is seen at one time.

Last Suboctile. I am very rarely able to recall any object whatever with any sort of distinctness. Very occasionally an object or image will recall itself, but even then it is more like a generalized image than an individual one. I seem to be almost devoid of visualizing power as under control.

Lowest. My powers are zero. To my consciousness there is almost no association of memory with objective visual impressions. I recollect the table, but do not see it.

Below is given the result of the self-classification of our seven subjects under the above divisions.

B.	G.	V. M.	W. M.	E. R.	L. R.	T.
First Octile or possibly first Quartile.	Last Octile.	First Octile.	First Octile.	Last Suboctile.	Last Quartile.	Last Quartile or possibly middlemost.

This result also agrees admirably with that given in the summary above.

III. *Imagination.*

1. *Passive Imagination.* (a) Method of Blots. The results obtained from the experiments under this method are susceptible of quantitative expression, but their qualitative aspect is of equal, if not greater, importance. The numerical results are given in Table IX, in which is shown, for each subject, the number of objects seen in each of the ten different blots, and the number of their sum.

The small figures at the left of the last column in Table IX indicate the order of the subjects in respect to the readiness of their flow of ideas,

TABLE IX.
Number of Objects seen in Blots.

	BLOT I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	TOTAL.
B.	5	7	8	5	9	1	5	14	14	13	1. 81
G.	1	4	4	6	5	2	4	3	3	6	5. 38
V. M.	6	6	10	6	6	5	7	8	8	6	3. 68
W. M.	4	3	3	1	4	3	2	3	3	1	7. 27
E. R.	4	4	5	3	6	1	5	4	2	3	6. 37
L. R.	6	8	7	6	6	7	8	6	6	10	2. 70
T.	3	5	4	6	3	6	5	9	8	6	4. 55

or the relative number of associative connections which are at the immediate command of the subjects. The *kind* of associations peculiar to the various individuals must, however, also be considered. The associated objects most frequently mentioned are animals; familiar fruits, plants, tools, household utensils, etc.; scientific objects such as geometric figures, mathematical symbols, schematic drawings, maps, etc.; objects suggested by literary reminiscence; and finally, objects from fable and mythology, such as monsters, fairies, witches, satyrs and centaurs. *B.*, who stands first in regard to number of objects seen in the blots, holds also a high place in respect to variety, since his reports show not only the names of animals and familiar objects, but associations derived from science and a few from mythology. *E. R.* and *M. W.*, who occupy a low position in respect to number of associations, have a corresponding place in regard to variety, since the associations are restricted almost exclusively to names of animals and familiar objects. Of the other subjects, *V. M.* and *L. R.* have shown a somewhat greater variety than *G.* and *T.*, especially in the way of fable and literary reminiscence. These differences in variety may be called the individual differences in regard to the source from which associations are habitually drawn. The reports from this test, however, show further peculiarities,—individual differences which, in general, subsist between single associations, and differences in the manner of reporting all the associations. For example: a particular blot may call up in the mind of a subject, through association, a number of objects similar to this in form, and he enumerates the objects one after another; while to another individual the same blot seems filled with pictures representing some action or situation, which are reported, often with touches of fancy or sentiment. This difference in the reports is sufficiently marked and sufficiently constant to form a basis for the classification of the individuals into two classes: one class rep-

representing the *constructive* or imaginative type, characterized by the putting together of concrete details in such a way as to form a significant whole; the other class, representing what may be called a *matter-of-fact* or scientific type, characterized by a process more purely analytic in its nature. The following reports from three subjects on Blot IX may serve to make plain the characteristic difference.

1. *Associations few and non-constructive.*

An eagle. Stuffed turkey. Head and neck of a musk-rat.

2. *Associations many and varied, but non-constructive.*

Ghost. Tadpole. Lizard. Ichthyosaurus. Mountains. Wigwams. Totem poles. A plain. A monument. Rocks. Pine trees. Sphinx. Satyr's head. Unknown animal (similar to giraffe).

3. *Associations numerous and constructive.*

Giraffe. Prehistoric bird in flight. Fairy riding on a humble-bee. Bit of tropical jungle, with trailing gray mosses and pools of water. Japanese lady. Bit of landscape with two hills and a valley between—an army encamped under one hill. Moss-grown log floating in water. Fabulous monster (griffin perhaps), walking off on his hind legs with a small Hottentot under his arm.

The constructive tendency is most prominent in *V. M.* and *L. R.* who also, next to *B.*, stand first in point of number and variety of associations; it is plainly discernible in *G.* and *T.*, though to a less degree in the latter than in the former; *B.*, *E. R.*, and *W. M.* must be classed as belonging to the other type.

(b) Test of associations with abstract terms, number forms, etc. None of the subjects had fixed associations with abstract terms, not even those subjects who are remarkably good visualizers. That this is the case tends to confirm the fact, observed by Galton, that persons dealing with highly generalized or abstract ideas habitually suppress any mental imagery that may tend to arise with them, and thus the very tendency disappears. No elaborate forms for the mental arrangement of number was reported by any of the subjects. *B.*, however, arranges the months in a vague circle with winter on the top and summer opposite; and *G.*, who has a color association with all words, letters, and figures, has extra and especial colors for the seasons, which take the form of disks arranged on the circumference of a circle. The latter fact is noticeable because the subject, apart from these color associations, visualizes very little.

2. *Constructive Imagination.* (a) *Mechanical Imagination.* The tests under this heading were two, the Magic Box and the Puzzle Watch. It will be remembered that the two points of explanation which the subjects should have given in regard to the first were the magnetized pivot, and the inner mechanism of gearing and fly wheel connected with the side-arm by means of which the impulse was given. The explanation of the Puzzle Watch lay in the connection of hands and works by means of an inner glass revolving disk and the regulation of the relative movement of the hands by means of tiny gearings in the central pivot. The explanations given by the different subjects may be tabulated as follows.

TABLE X.

*Magic Box.**Puzzle Watch.*

B.	1. Magnetized pivot. 2. Coiled spring inside released by lever pushed in.	First hypothesis, hands moved by magnetism, corrected in favor of second hypothesis: a plate of glass revolving with hands and a little system of cogs for relative motion.
G.	1. Alternate attraction and repulsion by electric current through pivot. 2. Electric battery inside; circuit closed by lever.	Perhaps hands were magnetized in some unknown way.
V. M.	No explanation.	Perhaps the hands were magnetized.
W. M.	1. Magnetized pivot. 2. Spiral spring inside.	Three hypotheses. First was perfectly correct. Second (which he preferred), invisible wire connection. Third (preferred to either), magnetization.
E. R.	1. Magnetized pivot. 2. Some kind of clock work inside.	Two inner glass disks, one revolving with pivot of minute hand and other with hour hand.
L. R.	1. Magnetized pivot. 2. Coiled spring inside tightened by pulling lever out.	No explanation.
T.	1. Attraction exerted through lid of the box by 2. A magnet inside made to move about in some way.	Suggested magnetism, but failed to see how it could be made to work.

In the first test the explanations given by *B.*, *W. M.*, and *L. R.*, are almost identical, while that of *E. R.* is similar but more indefinite. *T.* and *G.* come next in order with explanations which show that the correct idea is more nearly grasped by the former, while *V. M.* gives no explanation at all. In the second test, *B.*, after giving the hypothesis which suggested itself to nearly all the subjects (magnetism), changed this in favor of the correct explanation; while *W. M.*, who gave the correct explanation first, afterwards preferred to it two other erroneous hypotheses. *E. R.* gave properly the main idea of the explanation. A noticeable difference in the reports of the two tests is that *L. R.*, who gave one of the best explanations of the Magic Box, could offer no suggestion in regard to the Puzzle Watch. *T.*, *G.*, and *V. M.*, whose reports were on slightly different levels in the first test, all suggest the same vague hypothesis in the second. Taking into consideration the reports from both tests, and especially the lapse on the part of *L. R.*, it may be said in general that the subjects most proficient in mechanical inventions are *B.*, *W. M.*, and *E. R.*, a group which coincides with that classed in a previous test as belonging to the matter-of-fact or scientific type, a type showing analytical tendencies. The process here was mainly one of analysis; the coincidence in the grouping, therefore, is one that might have been expected. The classification of the subjects into two groups, with *B.*, *W. M.*, and *E. R.* on the one side and *V. M.*, *T.*, *G.*, and *L. R.* on the other, is also a

grouping according to sex. This may be significant, owing to the fact that men are, as a rule, more familiar with mechanical devices than women.

(b) Literary Imagination. (1) Development of sentences.

TABLE XI.

	Sentences developed using given substantives.		Sentences developed using given verbs.	
	Average number of sentences developed from one group of words.	Average quality of the sentences.	Average number of sentences developed from one group of words.	Average quality of the sentences.
B.	6. 3.5	5. 56	6. 2.6	5. 67
G.	2. 5.8	4. 68	2. 5.4	4. 71
V. M.	4. 4.5	2. 108	4. 3.4	2. 129
W. M.	5. 3.7	6. 55	5. 2.8	6. 69
E. R.	7. 3.2	7. 49	7. 2.5	7. 54
L. R.	3. 4.9	3. 105	3. 4.4	3. 128
T.	1. 6.6	1. 113	1. 5.8	1. 133

Table XI gives averages obtained from ten experiments with substantives and ten with verbs, five minutes being the time allotted for the development of sentences in each experiment. The columns of the Table headed *quality* demand some explanation. In general, quality stands for the degree of elaboration of the sentences, taking into consideration the length, rhetorical form, and especially the range of ideas expressed in a single sentence or in a series of sentences formed by the use of the same 'given' words. The sentences made showed three distinct degrees or stages of elaboration, which may be designated by *A*, *B*, and *C*, and smaller degrees of difference, intermediate between, or shading into these, which may be represented by the symbols of *plus* and *minus*. Sentences in which the three 'given' words were connected into a sentence by the use of as few words or ideas as possible were classed as *A*. Sentences which, by the addition of supplementary ideas, were more complete and definite in themselves, or which implied a context, were classed as *B*; while *C* was taken to designate those sentences in which the ideas were still further supplemented, and the literary form was correspondingly of a somewhat more elaborate character. For convenience in making averages, a numerical value was placed upon each of these symbols as follows: $A=50$, $A-=40$ and $A+=60$; $B=100$, $B-=80$ and $B+=120$; $C=200$, $C-=160$ and $C+=240$. According to this evaluation it will be seen from the Table that *B*'s sentences from

substantives average in quality between *A* and *A+*, and his sentences from verbs average between *A+* and *B-*. The other numbers under 'quality' are to be similarly interpreted. An instance of a sentence under each of the three main headings may serve to make the distinction between them more apparent.

Sentences formed by the use of the substantives, *citizen*, *horse*, *decree*.

A. "Decrees are made for citizens not for horses." (The connection of the words here is simple and mechanical.)

B. "That stalwart citizen on the great gray horse is a man to be trusted with the decree." (This implies a concrete situation.)

C. "All the well-to-do citizens of the village, each mounted on a horse, rode through the streets, proclaiming their dissatisfaction with the new decree." (A situation is here more fully outlined.)

A brief glance at Table XI shows two things: first, that every subject averages fewer sentences composed from 'given' verbs than from 'given' substantives; and, secondly, that every subject averages higher in quality in the latter than in the former. The reason for both facts lies in the greater definiteness with which the substantives determine the sentences: it is comparatively easy to make numerous sentences from definite substantives by changing the verbal connections, but it is difficult thus to change the entire character of the different sentences. The order that subsists among the individuals in regard to number of sentences is the same under substantives and under verbs, while the order in respect to quality is likewise the same under the two headings. If the order under number and under quality be compared, it will be seen that for three subjects, *T*, *L. R.*, and *E. R.*, the order remains the same, at 1, 3 and 7 respectively, both for substantives and for verbs; while, for the other subjects, the order is not radically changed. In general, then, the subjects who made the most sentences also made the most elaborate, and those who made the fewest sentences made also the simplest and most unimaginative. If the subjects are grouped according to their order in regard to number and also in regard to quality, the groups will be found to agree with those observed under the Method of Blots. The group which there showed a tendency toward constructive imagination, here show the same tendency, by their superiority in constructing sentences both as regards number and quality; while those who there showed a comparative lack of that tendency, here manifest the same characteristic by their lower rank in the construction of sentences. Within the constructive group *T*. has in this test advanced to the first place, showing that, to her mind, words possess a suggestiveness superior to that of mere visual outlines.

(2) Development of a theme.

The only quantitative estimate that can be satisfactorily made in this test is the average number of words which a subject uses in the development of a theme: the number of words corresponding roughly with the number of ideas presented. The average number of words

used by the various subjects in developing three themes by narration or description, and three by exposition are given below.

TABLE XII.

	B.	G.	V. M.	W. M.	E. R.	L. R.	T.
Narration or descrip- tion.	7. 124	5. 155	2. 179	3. 174	6. 150	1. 259	4. 173
Exposition.	7. 94	5. 138	3. 159	4. 147	6. 120	1. 222	2. 184

It may here be seen that all the subjects, save one, write longer themes on imaginative topics than on those requiring the treatment by exposition; that is, the topics which have to do with concrete things seem to lend themselves to more spontaneous expression than do the topics which involve the activity of the more purely intellectual processes. *T.* forms the marked exception. To judge from the length of her themes, those of exposition seem to be composed with even greater readiness than the narratives. The order subsisting among the individuals in regard to length of themes is slightly different in the two kinds of writing. This is due, however, to the exceptional difference in length on the part of *T.*; if this were left out of account, the order among the subjects would remain the same in the two cases. A comparison of this order with that in regard to the average number of sentences constructed by the different subjects (see Table XI) shows, as the most striking difference, that here *W. M.* has advanced to a position in the first group, while *G.* has fallen from the second to the fifth place. There are also smaller differences in the order among the individuals in the two groups. These alterations in the order are not of themselves, however, sufficient to warrant a change in the classification of the individuals by imaginative type. The qualitative differences in the themes must also be taken into account.

Narration and description deal with particulars, not with generalization. This imposes on both the same task of seeking out those parts and characteristics of the object which are most individual, most unlike those of the class to which it belongs; all the details chosen are selected with a view to bringing out this unique character of the whole object or event. The material is concrete, the process is mainly synthetic. Exposition, on the other hand is invention dealing with notions or generalized ideas; its business is to set forth the meaning of things, to make clear their nature, scope, and relations. "Exposition is thus," in the words of Prof. Genung, "the handmaid of all accurate and clearly-cut thought." Narration and description demand vividness or picturesqueness of diction, and a certain dramatic force; exposition calls only for clearness and simplicity.

An attentive perusal of the particular themes under consideration with the above qualifications in mind shows, in regard to the imaginative themes, constant individual differences. *L. R.*, *T.*, and *V. M.* here, as before, belonging to the constructive type, exhibit in the highest degree the requisite qualities of concreteness, vividness, etc. *B.* and *G.* seem to be on substantially the same level, their themes being less vivid, more matter-of-fact, with a tendency to generalize the scene or event, and with very slight emotional coloring; the themes of *E. R.* and *W. M.* show these characteristics to a more marked degree. The other set of themes, those dealing with exposition, gives little clue to individual differences, partly because the topics themselves are not such as to admit of very wide choice in the matter of treatment, and partly because the long course of intellectual training which all the subjects had enjoyed tended to lessen, in this sphere, the differences due to mental constitution.

(3) Choice of Topic.

TABLE XIII.

	In a Snowstorm.	A Polar Landscape.	A Puritan Sabbath.	My Opposite Neighbor.	Man Endowed with the Power of Flight.	Civilization not Regeneration.	Wisdom in Charity.	Friendship of Books.	Fiction as a Vehicle of Truth.	The Eloquence of the Bar and that of the Pulpit.
B.				X	X	X				
G.			X	X	X	X			X	X
V. M.			X	X	X	X			X	X
W. M.		X	X	X	X	X			X	X
E. R.		X		X			X	X	X	X
L. R.			X	X			X	X	X	X
T.				X			X	X	X	X

Table XIII shows the five topics chosen by each of the different individuals from the ten given topics, five of which were for imaginative, and five for expository writing. The results are chiefly interesting in their collective character. All the subjects showed a preference for the second class of topics, the number of these chosen by all the subjects being almost twice as great as the number of imaginative topics. The usual proportion in the choice of imaginative to expository topics, as shown in the table, is 2 : 3, the only exceptions being in the cases of *G.* and *L. R.*, whose proportion is 1 : 4. The imaginative topics least often chosen are those which make severest demands upon the imagination of the writer. That two of these least popular topics were selected by the three subjects who have been classed as showing less constructive imagination than the others is worthy of note. This, together with the fact that of the subjects who chose the larger proportion of expository topics, one has always been classed with the constructive type, and the other has usually been so classed, seems to

indicate that a particular power of imagination or comparative lack of it does not necessarily imply a preference for or against the exercise of that power in a given case. Tastes and abilities are not always co-ordinate.

The modification of the last two tests given to members of the Junior class show likewise a strong preference for expository subjects over imaginative: two subjects only chose the latter. The outlines for essays which accompanied the topics chosen were not sufficiently diverse in character to form a basis for classifying the individuals.

IV. *Attention.*

1. *Degree of Attention.* (a) Cancellation of vowels.

TABLE XIV.

	Pages with Spacing.			Pages without Spacing.		
	Percentage of Error.	Time (sec.).	Percentage of Error reduced to mean time.	Percentage of Error.	Time (sec.).	Percentage of Error reduced to mean time.
B.	8.7	189	3. 8.6	6.2	212	5. 5.5
G.	9.0	214	4. 9.9	3.4	272	4. 4.0
V. M.	3.9	196	2. 4.0	1.2	200	1. 1.0
W. M.	12.1	175	5. 10.1	9.3	198	7. 8.3
E. R.	11.9	198	6. 12.3	1.8	226	3. 1.9
L. R.	18.3	196	7. 18.8	8.2	214	6. 7.9
T.	3.6	164	1. 3.0	2.0	209	2. 1.8

Table XIV shows that, in the case of every subject, the time necessary to cancel a's from pages without spacing exceeds that for pages with spacing, but that the percentage of error in the former is less than in the latter. That is to say, the demands upon the attention were greater in the pages where absence of spacing, punctuation, and capitalization necessitated the perception of each letter as a unit. The separate direction of the attention upon every letter required more time than the perception of the letters grouped into words, with the added process corresponding to the question, "Does this word contain an a?"; but it also insured greater accuracy. The associative process indicated by the question might easily be crowded out by the more interesting associations called up by the meaning of the words and sentences. Distraction, then, operated in the case of proof pages to increase the percentage of error, while in the pages without spacing the increased difficulty of perception caused an increase in the time necessary to perform the task.

The reductions in the third and sixth columns of the Table were made in order to get a relative estimate of the individual which should take account of both quickness and accuracy. The assumption made is that in a given individual, maintaining a constant degree of attention while doing a piece of work, the percentage of error is inversely proportional to the time taken for the work. Under this assumption the percentage of error of each subject was reduced to a common time, the mean of the time for all subjects, and thus all individual differences were reduced to terms of error. The order of individuals in regard to this error is different in the different kinds of pages. *E. R.* rises from the sixth to the third place when the distraction due to the sense is removed: *B.* and *W. M.*, however, are comparatively lower in rank in the second class of pages than in the first. Other divergences of order are more slight.

In the first half of the Table, we find, apparently, three groups: *T.* and *V. M.*,—*B.*, *G.*, *W. M.* and *E. R.*,—*L. R.*; in the second half, also three groups: *T.*, *V. M.* and *E. R.*,—*B.* and *G.*,—*L. R.* and *W. M.*

(b) Comparison of ease (estimated by rapidity) in reading a page of concrete description (without spacing, etc.,) and a similar page of exposition of abstract thought.

TABLE XV.

	B.	G.	V. M.	W. M.	E. R.	L. R.	T.
Time of reading concrete page.	5. m. s. 4.38	6. m. s. 7.12	2. m. s. 3.10	4. m. s. 3.40	7. m. 15	3. m. s. 3.10	1. m. s. 2.23
Time of reading abstract page.	5. m. s. 3.36	6. m. s. 4.12	2. m. s. 2.48	3. m. s. 2.40	7. m. s. 6.45	4. m. s. 3.5	1. m. s. 2.5

Table XV shows that in the case of every individual the time for reading the abstract page was less than that required for the concrete page. There are several reasons why this should be the case. The practice gained by reading the concrete page was of assistance in reading the abstract page which came after. The abstract page had somewhat fewer words (340) than the concrete page (376), and also longer words, which are easier to distinguish than sequences of short words. Moreover, a considerable number of the longer words in the abstract page occurred several times, *e. g.*, such words as 'philosophy,' 'thought,' 'absolute,' 'consciousness,' etc. It cannot, therefore, be said that the superior rapidity of reading the abstract pages is altogether caused by a higher degree of attention resulting from the greater interest excited by the nature of the thought. The order of the subjects in regard to rapidity of reading is almost the same in the two pages; the only change in order being in the cases of *W. M.* and *L. R.*, whose rank alters from fourth and third to third and fourth respectively,—indicating that *W. M.* found the abstract page relatively easier to read than *L. R.* The order

of individuals as seen in Table XV and in the third and sixth columns of Table XIV are hardly comparable, since in the former no estimate is made of the correctness of the reading. Moreover the results in Table XV are made out from single experiments, while those in Table XIV represent the canceling of a's from eight pages with spacing and five pages without spacing. The latter results, therefore, have greater validity.

We regret that these two tests should be so bare of results, since they promise (if more skilfully performed) to yield indications of prime importance as to the make-up of the individual consciousness. We had expected to discover individual differences of much more definite character and much greater amount. The tests evidently involve processes of a highly complex nature, and the conditions must be very carefully regulated if reliable results are to be obtained.

2. *Range of attention.* (a) Writing letters while reading a passage of ten lines.

TABLE XVI.

	Times of Readings.					Number of Letters Written.				Difference in time between 5th and 1st readings.	Proportion of the difference in time to the number of alphabet writ'n.
	1st.	2d.	3d.	4th.	5th.	A.	A. B.	A. B. C.	Alphabet.		
B.	s. 28	s. 38	s. 42	s. 50	s. 113	47	62	78	91	s. 85	7.94
G.	22	22	22	21	28	29	34	39	40	6	.15
V. M.	29	30	30	30	50	40	56	57	46	21	.45
W. M.	26	27	27	27	29	27	28	36	13	3	.23
E. R.	27	27	29	27	31	31	40	48	20	4	.20
L. R.	22	25	26	25	37	41	44	51	26	15	.57
T.	27	29	30	31	29	36	40	45	25	2	.08

Table XVI is largely self-explanatory. The time of reading, in general, increases with the complication of the accompanying acts. The amount of this increase varies greatly in different individuals. The number of a, b's is greater than the number of a's, but not twice as great; and the number of a, b, c's is greater than the number of a, b's, but not three times as great as the number of a's. That is to say, it is more difficult to write ab repeatedly while reading than to write a simply, but the sequence between these two letters, a and b, is so easy and natural that it is not twice as difficult to write the two letters as to write the one; a subject, therefore, always sets down in the aggregate more letters

when required to repeat a, b than when writing a's. The case is similar with a, b, c. The conditions are different, however, in regard to the alphabet. There the number of characters and the sequences are so greatly increased that the total number of letters written is, in several cases, less than the number of a's; and even where the number of letters is not less, the time taken for the reading and writing is increased. The extreme complication of the acts accompanying the reading, in the case of writing the alphabet, tends to distract the attention from the reading, thus lengthening the time of reading, and to cause a decrease in the total number of letters written during the reading. Sometimes one effect predominates over the other: in *B.*, *e. g.*, it is the lengthening of the time, in *T.* the decrease in the number of letters. The last column but one of Table XVI gives the amount of increase of the time for the fifth reading over that for the first (or normal) reading. The last column, giving the proportion of this difference of time to the number of letters of the alphabet written, indicates the degree of simultaneity (if this expression be permitted) of the two acts. The smaller the increase in time and the greater the number of letters written the smaller is the proportion, and the more nearly simultaneous is the performance of the two acts. The order of the individuals in regard to range of attention as thus indicated in the last column of Table XVI does not correspond to any previous grouping of the subjects.

V. *Observation: Discrimination.*

1. *Descriptions of Pictures.* Of the two pictures used in these tests, "The Golden Wedding" and "The Interrupted Duel," the former, to a greater degree than the latter, gave results which varied from one individual to another. The first picture possessed far more detail, the composition was less simple, and the interpretation was somewhat less obvious. The descriptions of the "Golden Wedding" show that the observation of the subject may be primarily directed to the particular objects or details of the picture, or to the general arrangement of the objects, that is, the composition of the picture, or to the meaning of the picture, the story which it conveys, the details observed being such as lead up to this interpretation, or explain and apply the interpretation which is given first. The different ways in which the same picture appeals to the various individuals indicate differences in mental constitution. The appeal may be primarily to the intellectual activities of perception, or, through perception, to the imagination and feelings. The descriptions written by *V. M.*, *L. R.*, and *T.* give prominence to the interpretation of the picture, but differ in use of details. In the case of *V. M.*, the details are fairly numerous, concrete in their nature, and seem to be carefully chosen with a view to substantiating the interpretation; in that of *L. R.*, the details which are abundant and minute are given first, and then followed by an interpretation of the whole. In *T.*'s description the

details are less specific in character. The account of the picture given by *G.* contains a general interpretation, a mention of two or three prominent figures, and a general arrangement of the groups of people. The descriptions of *E. R.*, *W. M.*, and *B.* are characterized by entire absence of interpretation; but these subjects also vary in the use of detail. *E. R.* had no recollection of the composition of the picture at all, and mentioned, therefore, only a few objects in the form of an enumeration. *B.*'s description contains mention of a large number of persons and objects, but fails to give any clear idea of the composition of the whole; while that of *W. M.* contains less detail, but conveys a somewhat more complete idea of the total scene. The whole number of different objects (including persons, furniture, utensils, etc.) mentioned is 20: the number of these specifically referred to in one description varied according to the individual, from 6 to 13. *W. M.*, *E. R.*, and *T.* mentioned 6; *G.*, 1; *V. M.*, 8; *B.*, 11; and *L. R.*, 13. There was a considerable variety, therefore, in the objects selected for mention by the different subjects.—In the "Interrupted Duel" the total number of different objects mentioned was 15, and the proportion of these objects named in the different descriptions was much larger than in the case of the other picture. 8 and 12 were the limits of variation. *G.*, *W. M.*, and *T.* named 12; *B.*, 11; *V. M.*, 10; and *L. R.*, 8; *E. R.* failed to recall the picture at all. Since the scope for selection of objects was in this picture more limited, the descriptions of the different individuals were more similar in character. This similarity was further enhanced by the fact that the picture so plainly revealed the subject it was intended to represent, the result being that an interpretation of the picture was given by all (*E. R.* excepted), though that of *L. R.* was erroneous, owing to her failure to observe the minor group in the picture. The individual differences observable in the descriptions of the "Golden Wedding" tend to become neutralized in the "Interrupted Duel" by the greater use of interpretation on the part of *B.* and *W. M.*, and a somewhat less use of it by *L. R.*, *T.* and *G.* In *V. M.*, however, the tendency to interpret is, if anything, emphasized, and her description takes the form of a narrative, explaining the situation portrayed in the picture. For the reasons assigned above, the "Golden Wedding" is the picture better suited for a test of this kind. The results from it, therefore, may be accepted as revealing more characteristic differences in the individuals. These results are, as a matter of fact, in substantial agreement with those obtained in the tests for imagination.

2. *Observation of Colors.* In this test, it will be remembered, the subject was not given full information before the beginning of the experiment. It was only after he had looked at the card for the stated time (five seconds), that he was requested to name all the prominent colors on the card, with their respective situations. As the experiment could not be repeated under precisely the same conditions,

the test was given but once, and the results, therefore, may not be such as would be precisely confirmed by further testing.

TABLE XVII.

	Percentages correctly given.		Percentages incorrectly given.		Mean of (correct percentages—errors).
	Colors.	Situations.	Colors.	Situations.	
B.	50	25	0	12.5	6.
G.	75	62.5	0	0	1.
V. M.	37	37	0	0	5.
W. M.	62.5	12.5	0	0	4.
E. R.	25	0	12.5	0	7.
L. R.	62.5	62.5	0	0	2.
T.	50	50.0	0	0	3.
					31.25
					68.70
					37.00
					37.50
					6.25
					62.50
					50.00

The results are interesting as showing that the subjects who are the best visualizers observed the colors and the place they occupied in the picture less well than did others whose mental images are predominantly in some other sense department. *E. R.*, however, who proved to have the fewest and faintest visual images, seemed here, as in the previous experiment with pictures, to have the least power of reproducing visual impressions. Since the same subject showed relatively much greater facility in the reproduction of letters and figures under the method of procedure with knowledge, it is probable that in the case of the pictures attention was not sufficiently aroused to enable the subject to form verbal associations with the visual impressions. If these associations had been formed, especially with the colors, which were so few, they could hardly fail to be recalled so soon after their formation. It is to be further observed that the order indicated in the last column of Table XVII does not agree with the order in regard to particular objects mentioned in connection with either of the pictures of the previous tests. The general grouping of subjects, however, is somewhat similar in the two cases, if descriptions of pictures are considered in respect to their total merit; the chief differences being that *G.* and *W. M.* have in Table XVII advanced from their former positions. This fact may be of significance, when it is remembered that these two subjects excelled in the memory of unconnected visual impressions (letters and words).

3. *Discrimination of Synonyms.*

The discriminations were marked in regard to quality according to the scale of A, B and C, as described under the test of Development

of Sentences,—quality in this case, however, signifying the degree of clearness and completeness of a discrimination. *C.*, here as before, signifies the highest quality. The results of the averages of the numerical values given to the discriminations of the different subjects make it appear, as seen in the Table, that the value of *B.*'s discrimina-

TABLE. XVIII.

	Average quality of discrimina- tions.	Average length of discrimina- tions (words).	Total number of derivations.	Total number of examples.
<i>B.</i>	5. 89	7. 25	0	3. 14
<i>G.</i>	2. 106	6. 30	0	2. 2
<i>V. M.</i>	4. 97	2. 54	5	17
<i>W. M.</i>	6. 76	4. 44	0	2
<i>E. R.</i>	7. 77	5. 36	0	2
<i>L. R.</i>	3. 103	1. 65	0	1. 44
<i>T.</i>	1. 119	3. 49	0	4. 5

tions average about midway between *B—* and *B*, that of *G.*'s between *B* and *B+*, and so on. The remaining columns of the Table are self-explanatory. The limits of variation in quality for the different subjects the Table shows to be very narrow. The lowest quality (76) is almost *B—*, and the highest (119) is just less than *B+*. The tendency of the past training of all the subjects was towards cultivation of the powers of intellectual discrimination. There is no strongly marked parallel between clearness and completeness of the discrimination, and number of words used in its expression. *G.*'s discriminations are notable for clearness combined with conciseness of statement; for the rest, there seems to be a slight balance of clearness in favor of the longer discriminations. The tendency to illustrate the thought by means of concrete examples is shown most strongly in *L. R.*, *V. M.*, and *B.* Of these the two former have exhibited the same tendency toward the concrete in the development of themes. On the whole, this test, like that of the development of the topics for exposition, is of somewhat too general a character to bring out individual differences in regard to those activities in which the subjects most resemble each other by reason of their previous training and of the tendencies which lead to the choice of this training.

The discriminations of synonyms by members of the Junior class were more uneven in quality; but the presence of a considerable number of excellent discriminations tended to bring the mean value for the Junior students very nearly to that of the more advanced students.

VI. *Tastes.* (*Æsthetic Tests.*)

The Art, Music and Literary tests, which may be roughly classed as *Æsthetic tests*, gave the results noted in Table XIX.

TABLE XIX.

	ART TESTS.			MUSIC TESTS.		LITERARY TESTS.		
	Percentages of correct answers from given pictures.	Number named in five minutes.		Number of Musical Composers named in five minutes.	Percentages of correct answers as to compositions by given Composers.	Percentages of correct answers.		
		Famous Artists.	Famous pieces of Plastic Art.			Authors of given prose selections.	Authors of given poetic selections.	Sources of given poetic selections.
B.	54	21	18	16	90	62.5	62.5	25
G.	51	18	7	8	50	37.5	50.0	50
V. M.	43	15	12	11	40	87.5	62.5	50
W. M.	8	7	9	3	30	62.5	25.0	0
E. R.	10	2	7	9	20	50.0	62.5	50
L. R.	55	12	9	9	50	62.5	50.0	25
T.	63	37	14	25	100	75.0	87.5	75

The comparative results for the different subjects are more clearly shown in Table XX, in which the subjects are classified into the groups into which the numerical results in Table XIX seem to make them naturally to fall. The second part of Table XX summarizes for each subject the positions, according to groups, occupied throughout the tests, and gives also the final order of the subjects considering the æsthetic tests as a whole.

If it is assumed, as has been done in these tests, that a subject's knowledge of the best works and workers in the fine arts is some criterion of his appreciation of these arts, and if it is further assumed with Professor Külpe that "the æsthetic feeling originates in a relation of the perceived impression to the reproduction which it excites," i. e., that an impression which has a considerable, but not intense, degree of effectiveness for reproduction produces pleasure, it is interesting to note the final order of subjects, as seen in Table XX, in comparison with the order of subjects in regard to the average number of objects called up by association with given blots of ink. The similarity of order in this test and in that of blots is sufficient to call for remark. *V. M.* (2), *G.* (5), *E. R.* (6) and *W. M.* (7) remain the same in both; but while the order of *B.*, *L. R.*, and *T.* was (1), (3) and (4) respectively for blots, it became (3), (4) and (1) in the later test. The reason for this difference in order is not clear.

The questions in regard to favorite reading, preference for theater

TABLE XX.

	First Group.	Second Group.	Third Group.	Fourth Group.	Subjects and anal order.	First Group.	Second Group.	Third Group.	Fourth Group.
						times.	times.	times.	
Art Tests.	I. T., L. R., B., G., V. M.	E. R., W. M.			3. B.	4	3	1	
	II. T.	B., G., V. M., L. R.	W. M., E. R.		5. G.	1	4	3	
	III. B., T., V. M.	L. R., W. M.	G., E. R.		2. V. M.	4	4		
Music Tests.	I. T., B., V. M.	L. R., E. R., G.	W. M.		7. W. M.		3	3	2
	II. T., B.	G., L. R., V. M.	W. M., E. R.		6. E. R.		4	4	
					4. L. R.	1	5	2	
Literary Tests.	I. V. M., T.	B., W. M., L. R.	E. R., G.		1. T.	8			
	II. T.	B., V. M., E. R.	G., L. R.	W. M.					
	III. T.	G., V. M., E. R.	B., L. R.	W. M.					

or opera, fondness for reflective games, etc., produced answers which, in several cases, threw light upon changes in the grouping of the subjects in the three different classes of æsthetic tests. It is unnecessary to cite the answers here; it is enough to state that the questions proved to be worth asking.

The art tests with photographs and the music tests which were given to the Juniors showed, as a result, a uniformly lower percentage of correct answers in both cases. The individual differences were of slightly smaller range but were fairly constant throughout the tests.¹

§ 6. Conclusion.

It is not our intention to print in this place a complete summary of the results of all experiments for the different individuals. Such a summary, has, of course, been made by us; but, in the first place, it leaves too many gaps to allow a definite differentiation of each individual from all the others, owing largely to the limited bounds within which the enquiry was purposely confined, while, secondly, we have considered it best that the reader, if he will, shall make such a summary for himself, and in this way form his estimate of the value of the tests. Our aim was principally to investigate the merit of a general method: to find the value for Individual Psychology of experimentation applied to the more complex mental activities, as well as the practicability of certain specific tests, many of which had been suggested by the advocates of such experimentation.

It will be remembered that we noted above two main problems of Individual Psychology; the first problem having reference mainly to *variations* themselves, that is, to the way in which psychical processes vary in different individuals, and according to classes of individuals; the second, to the *relations* among variations. The latter, to be sure, includes the question how individuals vary in regard to psychical processes, but it goes on further to ask how these individual variations are related to each other, when the whole range of mental processes is considered. It is this part of the problem to which attention has been directed in the present investigation, by means of the third method mentioned in the preliminary discussion, *i. e.*, the 'method of tests.'

¹ A remark should be made in regard to the absence of detailed discussion of results from the Junior students. The purpose in view when the tests were first given to the Juniors was to compare results from the class as a whole with the general results from the advanced students. Since, however, the exclusive use of the collective method restricted the number of tests which could be given to the Juniors, and the occasional absence of different individual members of the class caused incompleteness in the tests that were given, it was impossible to compare, step by step, the variations as seen in the advanced students with those observed in the Juniors. The comparison, therefore, could be made only in a general way. This comparison has, nevertheless, been found to be useful, and a careful working over of all the results convinces us that the idea upon which it was based was well warranted. Had the scope of the testing been somewhat more extended, results of interest and importance could, we believe, have been obtained.

The results, we believe, have shown that, while a large proportion of the tests require intrinsic modification, or a more rigid control of conditions, others have really given such information as the Individual Psychologist seeks. Thus the tests for Imagination proved to be important as forming a basis for a general classification of the individuals, according to fairly definite types; and results from other tests gave some force of confirmation to this classification, as *e. g.*, the test on Observation by description of pictures. In general, however, a lack of correspondences in the individual differences observed in the various tests was quite as noticeable as their presence. The total change in the order of subjects in the memory of single short series of words and in the recapitulation of the words of seven short series, the fact that those subjects who showed best observation of colors were not the best visualizers, are instances of this lack of correspondence, of which many others could be cited. Whether the fact indicates a relative independence of the particular mental activities under investigation, or is due simply to superficiality of testing, can hardly be decided. While, however, we do not reject the latter possibility, we incline to the belief that the former hypothesis is in a large proportion of cases the more correct.

But little result for morphological psychology can be obtained from studies of the nature of the above investigation. So many part-processes are involved in the complex activities, and the manner of their variation is so indefinite, that it is seldom possible to tell with certainty what part of the total result is due to any particular component. It is doubtful if even the most rigorous and exhaustive analysis of test-results would yield information of importance as regards the structure of mind. At all events, there is not the slightest reason to desert current laboratory methods for the 'method of tests.'

The tests employed, considered as a whole, cannot be said to yield decisive results for Individual Psychology if applied *once* only to individuals of *the same class*. This statement the above discussion of tests seems perfectly to warrant. *Series of such tests* are necessary in order to show constant individual characteristics. The tests, to be sure, (1) if enlarged in extent to cover a wider range of activities, might be useful for roughly classifying a large number of individuals of very different training, occupation, etc., provided that the greatest care were taken that the conditions in the case of each individual should be as favorable as possible. And, on the other hand, (2) certain groups of tests, especially selected for a particular purpose, and applied, once each in series, to a limited number of individuals, might yield valuable information on points which particular circumstances rendered

of practical importance. As engineers, pilots, and others who have to act upon information from colored signals, are roughly tested for color blindness, so other classes might often profitably be submitted to a psychological testing of those higher activities which are especially involved in their respective lines of duty.

All this, however, is largely beside the point; much preliminary work must be done before such special investigations can be of any great worth. This appears plainly from the present investigation where the positive results have been wholly incommensurate with the labor required for the devising of tests and evaluation of results. In the present state of the science of Individual Psychology, there can be little doubt that the method of procedure employed by M. Binet is the one most productive of fruitful results: that, namely, of selecting tests, and applying them to a number of individuals and classes of individuals with a view of discovering the chief individual differences in the mental activities to which appeal is made. To this should be added, however, an exhaustive study of the results from series of similar tests given to a small number of individuals at different times and in varying circumstances, in order to discover how constant the differences are, and how much of the variation may be due to changes in mental and physical condition, environment, etc. When this procedure has been followed for tests that cover all the principal psychical activities, then the investigation of limited groups of individuals for the purpose of characterizing them in respect to their mental differences may be undertaken with hope of easy and accurate results. The previous study will have made clear the many conditions involved, and the best way of modifying the 'test method' to suit varying circumstances.

In fine, we concur with Mm. Binet and Henri in believing that individual psychical differences should be sought for in the complex rather than in the elementary processes of mind, and that the test method is the most workable one that has yet been proposed for investigating these processes. The theory of the German psychologists, who hold that the simplest mental processes are those to which the investigator should look for a clue to all the psychical differences existing among individuals, we believe would be productive of small or, at any rate, of comparatively unimportant results. Whether the anthropometrical tests so largely used by American workers in this field of psychology will lead to any such correlation of these traits with those of a purely psychical character as has been suggested by some pursuing the inquiry, is a question which must be left for the future to decide. No adequate data are as yet at hand, and (as has been stated above) the American

workers have formulated no explicit theory of Individual Psychology. The method here outlined should (and may), however, be rendered more exact by modifications in accordance with the procedure of the German investigators of Individual Psychology. A combination of the principal characteristics of the two methods is, then, it seems to us, best calculated for the attainment of satisfactory results.

PAIN AND STRENGTH MEASUREMENTS OF 1,507 SCHOOL CHILDREN IN SAGINAW, MICHIGAN.

By ADA CARMAN, Washington, D. C.

These measurements of least sensibility to pain, together with those of greatest strength, were made on 1,507 public school children in Saginaw, Michigan, through the permission and courtesy of Mr. A. S. Whitney, school Superintendent.

The instruments used in these experiments were a temple algometer and a hand dynamometer.

The temple algometer was designed by Arthur MacDonald, specialist in the U. S. Bureau of Education, and consists of a brass cylinder, with a steel rod running through one of the ends of the cylinder. This rod is attached to a spring and the cylinder is provided with scale and marker. The scale is graduated from 0 to 4,000 grammes. A brass disk 15 millimeters in diameter, at the end of the rod, is covered with flannel, so as to exclude the feeling of the metal when pressed against the skin.¹

The disk is pressed against the temporal muscle, and as soon as the subject reports the pressure to be in the least disagreeable the amount is read from the scale. The purpose is to approximate as near as possible to the threshold of pain.

The Collin dynamometer was used.

Before the experiments were made the pupil answered the following questions in writing :

Name,

Age,

Sex,

Order of birth, 1st, 2d, or later born,

Color of hair,

Color of eyes,

Right or left handed,

Nationality of father and mother,

Education of father and mother,

Occupation of father and mother,

When the pupil could not answer any of the questions he was helped by his teacher or by the experimenter. At least twenty-five per cent. did not know the color of their hair, and at least fifty per cent. did not know the color of their eyes.

¹ Described and illustrated in the *Psychological Review*, July, 1898.

Most of the children were of foreign parentage of the laboring classes, by which is meant artisans and unskilled laborers.

The tables give in grammes the least sensibility to pain by pressure on the temporal muscle, and in kilogrammes the greatest strength by grasp of hand.

TABLE I.

Boys.

Nearest Ages.	No. of Persons.	Right Temple. Averages.	Left Temple. Averages.	Right Hand. Averages.	Left Hand. Averages.
10	96	2253	2191	16	14
11	104	2359	2337	19	15
12	123	2359	2337	21	18
13	152	2447	2432	22	20
14	101	2629	2523	26	23
15	79	2738	2656	30	27
16	53	2824	2700	35	30
17	33	3036	3023	40	35
18	15	3267	3077	42	38
10-18	756	2493	2466	24	21

TABLE II.

Girls.

Nearest Ages.	No. of Persons.	Right Temple. Averages.	Left Temple. Averages.	Right Hand. Averages.	Left Hand. Averages.
10	86	1874	1827	11	10
11	102	2107	1983	13	12
12	132	1873	1788	15	14
13	107	2017	1997	18	16
14	84	1955	1961	20	17
15	82	2218	2165	21	18
16	66	2433	2283	21	18
17	48	2360	2330	23	22
18	25	2478	2374	24	22
19	19	2937	2705	23	20
10-19	751	2097	2030	17	16

TABLE III.
First born—Boys.

Nearest Ages.	No. of Persons.	Right Temple. Averages.	Left Temple. Averages.	Right Hand. Averages.	Left Hand. Averages.
10	20	2180	2178	15	12
11	40	2420	2363	18	16
12	31	2421	2390	21	18
13	55	2537	2461	22	20
14	25	2390	2208	27	23
15	23	2354	2189	29	26
16	20	2845	2603	38	33
17	8	3288	3163	43	37
18	4	3575	3275	40	37
10-18	226	2506	2405	24	21

TABLE IV.
First born—Girls.

Nearest Ages.	No. of Persons.	Right Temple. Averages.	Left Temple. Averages.	Right Hand. Averages.	Left Hand. Averages.
10	29	2167	2193	11	10
11	21	2136	2133	13	12
12	36	1956	1815	15	14
13	29	2174	2140	18	16
14	24	1973	1985	20	16
15	23	2203	1963	22	19
16	24	2369	2169	20	17
17	18	2344	2386	23	21
18	7	2236	2086	20	20
19	4	2825	3125	22	19
10-19	215	2163	2096	17	16

TABLE V.
Second born—Boys.

Nearest Ages.	No. of Persons.	Right Temple. Averages.	Left Temple. Averages.	Right Hand. Averages.	Left Hand. Averages.
10	28	2102	2009	16	14
11	15	2520	2570	18	16
12	28	2218	2115	21	19
13	31	2442	2490	23	21
14	28	2702	2613	25	23
15	15	3000	2847	31	27
16	15	2723	2708	31	28
17	8	3050	3500	38	35
18	4	3213	3113	40	33
10-18	172	2519	2489	24	21

TABLE VI.
Second born—Girls.

Nearest Ages.	No. of Persons.	Right Temple. Averages.	Left Temple. Averages.	Right Hand. Averages.	Left Hand. Averages.
10	28	1746	1714	11	10
11	35	2120	1929	13	11
13	32	1652	1633	15	13
13	24	1948	2023	17	15
14	18	2194	2142	20	17
15	19	2258	2289	23	19
16	16	2572	2397	20	19
17	9	2183	2211	21	22
18	2	3225	3150	28	21
19	6	3100	2717	21	21
10-19	189	2069	2008	17	15

TABLE VII.
Later born—Boys.

Nearest Ages.	No. of Persons.	Right Temple. Averages.	Left Temple. Averages.	Right Hand. Averages.	Left Hand. Averages.
10	48	2372	2302	16	14
11	49	2260	2245	18	15
12	64	2374	2409	20	17
13	66	2375	2381	23	20
14	48	2711	2635	26	23
15	41	2857	2849	30	25
16	18	2881	2803	33	29
17	17	2912	2732	39	35
18	7	3121	2943	45	42
10-18	358	2527	2493	24	21

TABLE VIII.
Later born—Girls.

Nearest Ages.	No. of Persons.	Right Temple. Averages.	Left Temple. Averages.	Right Hand. Averages.	Left Hand. Averages.
10	29	1703	1534	11	11
11	46	2004	1957	13	12
12	64	1938	1843	15	13
13	54	1964	1908	18	16
14	42	1843	1869	19	17
15	40	2208	2221	20	17
16	26	2406	2317	21	19
17	21	2498	2333	24	23
18	16	2491	2403	25	24
19	9	2878	2511	24	21
10-19	347	2080	1998	18	16

Taking the tables of boys we find (Table I) that the sensibility to pain decreases as age increases, except at the age of twelve. The strength of grasp shows a regular increase. The left temple is more sensitive than the right temple.

Sensitiveness to pain decreases in order of birth (Tables III—VIII), first born boys being more sensitive than second born, and second born more sensitive than those of later birth. The strength of grasp is the same.

Divided into light and dark, based on color of eyes and hair, the boys with light eyes and hair are less sensitive and less strong than those with dark eyes and hair.

	Ages.	No. of Persons.	Average Sensibility.		Average Strength of Grasp.	
			Right Temple.	Left Temple.	Right Hand.	Left Hand.
Dark,	10-18	356	2462	2408	25	22
Light,	10-18	400	2570	2518	23	20

Of the 756 boys, 5 per cent. were left-handed, with an average of

Right Temple,	Left Temple.	Right Hand.	Left Hand.
2439	2359	21	19

Boys reported by their teachers as bright were more sensitive than those reported as dull, and while stronger in the right hand, were weaker in the left hand than the dull.

	Average Sensibility.		Average Strength of Grasp.	
	Right Temple.	Left Temple.	Right Hand.	Left Hand.
Bright,	2158	2152	21	17
Dull,	2256	2217	20	18

Those reported as being especially dull in mathematics were more sensitive on the right temple than on the left temple, with an average sensibility of 2,015 on the right temple and 2,281 on the left temple. Strength of grasp, right hand 21, left hand 18.

All averages as to brightness and dullness are based on ages 10-14 inclusive, number of pupils 576.

With the girls (Table II) the decrease of sensibility to pain as age increases is not so regular as with the boys, though there is a general decrease. As with the boys the left temple is more sensitive than the right.

The first-born girls show less sensibility to pain than second-

born; later born less than second-born on left temple, but more on right temple (Tables IV, VI, VIII.). The strength of grasp varies.

Girls with light hair and blue or gray eyes are less sensitive to pain on left temple, and less strong than girls with dark hair and dark eyes. On right temple they are more sensitive than the dark.

	Ages.	No. of Persons.	Average Sensibility.		Average Strength of Grasp.	
			Right Temple.	Left Temple.	Right Hand.	Left Hand.
Dark,	10-19	402	2113	1840	18	16
Light,	10-19	349	2084	2022	17	15

Of the 751 girls 3.6 per cent. were left-handed, with an average of

Right Temple.	Left Temple.	Right Hand.	Left Hand.
1922	1952	21	19

Girls reported as bright were more sensitive and stronger than those reported as dull.

	Average Sensibility.		Average Strength of Grasp.	
	Right Temple.	Left Temple.	Right Hand.	Left Hand.
Bright,	1737	1736	16	13
Dull, .	2094	1868	13	12

Those reported as being especially dull in mathematics were more sensitive on the right temple than on the left, with an average sensibility of 1,688 on the right and 1,763 on the left. Strength of grasp, right hand 14, left hand 13.

Averages as to brightness and dullness are based on ages 10-14 inclusive, number of pupils being 571.

As a summary we give the following:

With both boys and girls sensitiveness to pain decreases as age increases.

The left temple is more sensitive than the right temple.

Girls are more sensitive and weaker at all ages than boys.

In general, sensitiveness to pain decreases in order of birth, the exception being that later born girls are slightly more sensitive on the right temple than are the second born. Were the number of second born girls larger this exception might not occur. Strength of grasp remains the same with boys, while it varies with girls.

Boys with light hair and eyes are less sensitive and less strong than boys with dark hair and eyes. Girls with light hair and eyes are less sensitive on the left temple, but more sensitive on the right temple than girls with dark hair and eyes. They are also less strong.

Bright boys and girls are more sensitive to pain than dull boys, and in general are stronger.

Boys and girls especially dull in mathematics are more sensitive on the right temple than on the left temple.

SUGGESTIONS TOWARD A LABORATORY COURSE IN COMPARATIVE PSYCHOLOGY.

By LINUS W. KLINE, Ph. D.

"In no case may we interpret an action as the outcome of the exercise of a higher psychical faculty, if it can be interpreted as the outcome of the exercise of one which stands lower in the psychological scale."—*C. Lloyd Morgan*.

"But why should we bind ourselves by a hard and fast rule. . . ? Is it not the truth at which we wish to get? For myself, I am becoming more and more skeptical as to the validity of simple explanations for the manifestation of animal life whether physical or psychical."—*Wesley Mills*.

The following experiments in comparative psychology were devised to fill a small part of the work offered at Clark University in the Psychological Practicum.¹

I have been guided by two principles in selecting animals for experimentation: (1) general distribution of the species; (2) an animal little influenced by captivity and permitting a variety of experiments of a psychological value.

The animals thus selected are regarded as typical, *e. g.*, earth worms of vermes, slugs of mollusca. A careful study of the instincts, dominant traits and habits of an animal as expressed in its free life—in brief its natural history should precede as far as possible any experimental study. Procedure in the latter case, *i. e.*, by the experimental method, must of necessity be largely controlled by the knowledge gained through the former, *i. e.*, by the natural method. In setting any task for an animal to learn and perform, two questions should be asked: (1) Does it appeal to some strong instinct? (2) Is it adapted to the animal's range of customary activities?

The adage, "Make haste slowly," is highly applicable to the present field of scientific work, not only in working with the animals, the manual execution, but especially in the matter of drawing inferences and interpreting the facts.

The work as a whole, on account of its newness, must be regarded as tentative. And notwithstanding the fact that the problems and experiments here outlined have been largely

¹Experiments on Arthropoda (daphnia, crayfish, bees, ants, and wasps), Amphibia (frog, newt), Reptilia (lizard, turtle), and Canidae (dog) are omitted from this paper for the reason that many of them are yet untested or are in the process of making.

selected from the works of the foremost scientists in their respective fields, and further that I have retested their "workableness" in many cases from the standpoint of psychology, they still belong to the suggestive stage and must remain such until they are extensively tested—not merely discussed—by student and teacher in a number of laboratories.

The literature given here, although by no means exhaustive, contains in every case matter pertinent to the subject. The aim is to acquaint the learner with a few of the best works in the field, leaving the minor ones to his own industry.

The hope that the present outline will awaken a wider interest and enlist a larger co-operation in testing the value of the methods here set forth is my only justification for presenting this paper.

The nature of this work has necessarily put me under obligations to many persons.

For the greater part of the material itself I am indebted to those from whose works I have drawn and to whom I make acknowledgments in the references accompanying the experiments. For the original plan of the work, and for seeing that ample laboratory material was provided me, together with much assistance in the arrangement of the subject matter of this paper, I make grateful acknowledgments to Dr. Edmund C. Sanford.

I am thankful to President Hall for the loan of books from his library, and for the inspiration received from his hearty approval of the work itself.

To Dr. C. B. Davenport, of Harvard University, I feel greatly indebted, not only for the several experiments selected from his published works, and citations to literature, but also for personal suggestions and his keen interest in the purposes of the work.

AMOEBA.

The chief psychological interest in Amoeba is the variety of activities that it is able to perform with an apparently undifferentiated structure. It feeds, it gets rid of waste material, it reacts to stimuli, it moves from place to place, and it reproduces by division.

The student should observe carefully to what stimuli it appears responsive, and especially any cases of apparent selective activity in the taking of food, and in the latter case should consider whether or not the act in question requires a psychical explanation.

Probably¹ the simplest and surest method of securing Amoeba

¹ Behla, Robert: Die Amöben, insbesondere von Parasitären und culturellen Standpunkt. Berlin, 1898.

This excellent little monograph, besides containing a bibliography

is from green grasses taken from streams and ponds. Put a small handful of such green material in a large evaporating dish, and barely cover it with tap water. Amoeba may be found at once. I get better results by waiting three or four weeks, replacing in the meantime the evaporated water.

Such material answers every purpose for observing the life processes of the Amoeba. By permitting the glass slide to dry up by evaporation Amoeba's reaction to desiccation may be observed.

It is convenient¹ to rest the four corners of the cover slip on small bits of glass of uniform thickness cemented together, or better still on four wax feet which admit, by pressure, of regulating the space between cover slip and slide—say $1\frac{1}{2}$ mm. apart.

VORTICELLA.

The qualities of this infusoria that lead to its selection for study here are: first the easy observation of the same individual for a considerable period of time, due to its permanent attachment; second, the variety and clear cut character of its activities and the fact that they are performed in a comparatively short cycle; and third, the fundamental and suggestive character of these activities, viz.: contraction of stalk, movements of cilia, food-taking, reproduction, etc.

Place in a medium size glass jar a bunch of grass blades gathered from a running stream, or pond; cover with water. Vorticella may be found in abundance on the decaying grass within a week or ten days. They will "hold their own" in the

and descriptive account of Amoeba in the interests of medicine, treats historically of the many attempts to obtain a pure culture of Amoeba. No one method is as yet satisfactory. Dr. Behla, himself, recommends the following: 25 grs. of flaxseed stalks, placed in a liter of water 48 hours. Filter, and to the filtrate add a 1% solution of agar and sodium carbonate until the solution becomes alkaline. *Amoeba Spinosa* develops in large quantities. Ogata, according to Behla, put into a large evaporating dish, partly filled with water, green grass taken from an open canal. It proved to contain Amoeba and Infusoria. He put a few drops of this water into a test tube, which was filled with the following nourishing solution kept in a sterilized vessel: a filtered solution of 50cc of tap water containing 2.5% grape sugar. To separate the infusoria from the bacteria he dipped into the test tube capillary tubes 10-20 cm. long and 0.4-0.6 mm. in diameter filling them with the culture medium. Sealed the ends in a flame. The entire length of the tube was examined under a microscope and the region exceptionally plentiful in Amoeba, and freed from other forms, was marked and broken off.

¹Those who may desire to study Amoeba's reactions to a single stimulus, e. g., light, temperature or chemical, should consult Verworn's *Psycho-Physiologische Protisten-Studien*, Jena, 1889; J. Loeb's *Der Heliotropismus der Thiere*, pp. 118, Würzburg, 1890; and Davenport's *Experimental Morphology*, Vol. I, pp. 155-218.

aquarium for several weeks, after which they succumb to other forms.

Their form¹ and structure² are described in manuals of zoölogy.

Select one in a quiescent state, and by using magnification from 375 to 425 diameters, draw the following structures: calyx (the bell shaped body), the peristomal lip or lid to the calyx; the stalk, and ribbon like contractile tissue (draw these contracted and extended), the contractile vesicle and band like nucleus.

Activities. I. Vegetative. Do you discover any rhythm in the contraction of the vesicle? Does the stalk contract when the calyx and cilia³ come in contact with any rigid, resisting, unmanageable object, or is it indifferent to some, while it avoids others;—*i. e.*, does it seem to distinguish between harmful and harmless objects?

Put *Vorticella* in a continuous current of distilled water brought from a reservoir by means of a glass syphon, drawn to a capillary point, placed at one side of the cover-slip and a filter-paper drip applied to the other side. Is there any uniformity in *Vorticella*'s reactions to the current?⁴ Put yeast⁵ grains into the reservoir—note behavior toward them—try very fine pulverized chalk, salts of barium, pepsin. Do you find any uniformity in *Vorticella*'s reaction toward these substances. Are the cilia selective in the matter of food getting,⁶ or do they admit all sorts of material indifferently at one time and reject all food material whatever, at other times, owing, perhaps, in the latter case to satisfied hunger?

II. Reproductive. Reproduction in *Vorticella* may take place by fission or by gemmation. The former process may frequently be seen, the latter less frequently.

The first signs of multiplication by fission may be seen in the calyx taking on a roundish form, the longitudinal axis shortening. Follow and note all the changes from this stage on till complete division takes place. Note preparations made by the daughter *Vorticella* previous to its leaving the mother stalk. Do you observe anything that indicates a difference in the sensitivity on different parts of the calyx?

¹Kent, Saville: *Manual of Infusoria*, p. 675.

²Nicholson, H. A.: *A Manual of Zoölogy*. p. 100.

³Hodge and Aikens: *Am. Jour. of Psychology*, Vol. VI, No. 4.

⁴Kline, L. W.: *Am. Jour. of Psychology*, 1899, Vol. X, No. 2, p. 260.

⁵Commercial yeast may be used—should be dissolved in sterilized water.

⁶Weir, James: *The Dawn of Reason*, N. Y., 1899, p. 8.

PARAMECIA.

This hardy, prolific, and swiftly moving infusoria readily responds to a wide range of primitive stimuli, such as gravity, light, contact, temperature and chemical substances. Observations of the responses of such a one celled organism to this varied group of stimuli must be both interesting and instructive to the psychologists.

Paramecia occur in abundance in stagnant water containing decaying vegetable matter.¹ Two or three weeks before they are needed, put hay or grass in a jar of water, and keep in a warm room. In such a jar they may be kept for indefinite periods in immense numbers. To prevent the paramecia on the slide from moving too rapidly, it is advisable to put them in a 2.5% solution of gelatine in water. Study first with the low power, then with the high.

The following structures should be made out: the position and shape of the buccal cavity, nucleus, contracting vacuoles, non-contracting vacuoles, cilia, and trichocysts.

*Movements of Cilia.*² Remove a large number of Paramecia from the culture medium by means of a pipette on to a glass slide. Cover the preparation with a cover glass supported by glass rollers of capillary fineness and of *uniform thickness*. Thrust under the cover slip a couple of pieces of fine capillary glass tubing.³ After the Paramecia begin to collect along these glass tubes as well as the glass rollers, run carmine water under the cover glass; select a quiet individual and observe how the carmine grains pass by it. Indicate by arrows placed outside the periphery of your drawing the direction of movement of the carmine. What do you infer concerning the movement of the cilia? Do the grains whirl as much about a moving individual as about a quiet one? Can you explain?⁴

Geotaxis. The effect that gravity⁵ has in determining the verticality of the body and thereby determining the direction

¹Kent, Saville: A Manual of the Infusoria. Vol. II, pp. 483-488. Pl. 26, Figs. 28-30.

²Jennings, H. S.: Reactions of Ciliate Infusoria. Jour. Phys., 1897, Vol. XXI, p. 303.

³Ludloff in studying the motions of the cilia in electrotaxis confined the animals in a thick gelatine solution. Jennings considered their motion in such a medium as abnormal and recommends water containing carmine grains.

⁴Taken from Davenport's outline of requirements in zoölogy for use in preparing students for Harvard University.

⁵Verworn, Max: Ueber die Fähigkeit der Zelle, activ ihr spezifisches Gewicht zu verändern. Pflüger's Archiv, Vol. LIII, 1892, pp. 140-155. See also by the same author: Psycho-Physiologische Protisten-Studien, pp. 121-122.

of locomotion is termed geotaxis.¹ Creatures whose axial orientation and consequent locomotion are perceptibly influenced by this force are geotactic.²

(a). Fill half full with the culture medium of *Paramecia* a glass tube $1\frac{1}{2}$ cm. in diameter and 60 cm. in length. Keep the tube vertical and in uniform temperature and light—not direct sunlight. After a few hours the organisms will be found at and near the surface of the water.

(b). Fill the remaining half of the tube with hydrant water, and, keeping it vertical as before, note the results. Twelve or fifteen hours later they may be found 3 to 6 cm. from the surface of the water (see chemotaxis). Turn the tube bottom side up and observe the time for complete migration to the upper³ end.⁴

A rough and ready demonstration of this geotactic response may be found by filling a test tube nearly full of the culture medium. To prevent the free end becoming richer in oxygen, seal with an impermeable plug of wax or a rubber stopper. Do not expose the tube to direct sunlight. For the theoretical interpretations of the geotactic responses the student is referred to the works of Verworn, p. 141; Jensen, pp. 462-476; Davenport, pp. 122-124. (See literature given below.)

Chemotaxis. (a). Remove a large number of *Paramecia* from their culture medium by means of a pipette on to a glass slide. Drop into their midst a small bit of decaying vegetable or animal material. Cover the preparation with a cover glass supported by capillary glass rollers of uniform thickness. Note the behavior of *Paramecia* toward the decaying material.

(b). Introduce under the cover glass, by means of a pipette drawn to capillary fineness, rancid oils, *e. g.*, olive oil, cod-liver oil. Use also a drop of water from putrefying meat, beef ex-

¹Jensen, Paul: Ueber den Geotropismus niederer Organismen. Pflüger's Archiv, 1892, Vol. LIII, pp. 428-480.

²Davenport. C. B.: Experimental Morphology Vol. I, pp. 112-125.

³Advantage may be taken of the negative geotactic activity of *Paramecia* for securing large numbers in a small quantity of water. It also serves as a means for washing out the water in which they were bred.

⁴Miss Platt (The Amer. Nat., Vol. XXXIII, No. 385, Jan., 1899,) and Dr. Jennings (Amer. Jour. of Phys., Vol. II, 1899,) report that *paramecia* in this country are not so markedly geotactic as those used by European investigators. During the fall and early winter of '98 I brought large numbers into small volumes of water by taking advantage of the geotactic responses which they then so readily displayed. In April, '99, I had an occasion to repeat the process. My efforts failed. The *paramecia* remained scattered throughout the length of the tubes for several days. Both spring and fall cultures were of the same species and reared in similar mediums.

tract, etc. It is best to use a fresh lot of *Paramecia* for each new substance.

(c). The following salts, acids, and alkalies were used by Dr. Jennings.¹

Substance.	Wk. Sol.	Stg. Sol.	Substance.	Wk. Sol.	Stg. Sol.
Copper Sulphate	+	(²)	Sodium chloride	—	—
Sulphuric acid	+	—	Sodium carbonate	—	—
Hydrochloric acid	+	—	Sodium bicarbonate	—	—
Acetic acid	+	—	Potassium hydroxide	—	—
Nitric acid	+	—	Sodium hydroxide	—	—
Tannic acid	+	—	Potassium bromate	—	—
Mercuric chloride	+	—			

² + = positive and — = negative chemotaxis.

Solutions of H_2SO_4 of the following strengths give positive chemotactic reactions: 10000 %, 20000 %, 40000 %, 80000 %, 160000 %.

(d). Repeat experiment (b) under geotaxis and note that after they have gathered at the surface they recede or fall from 3 to 6 cm. from the surface. Can you explain?

(e). Repeat (a) using a bit of filter paper or a small piece of linen fibre. After they have collected in large numbers about these objects, withdraw by means of a capillary pipette a drop of water from within the area to which the *Paramecia* are confined. Inject this drop beneath the cover glass of a second preparation in which *Paramecia* are uniformly distributed. The behavior of *Paramecia* to this new fluid should be very carefully observed. Their behavior under conditions in experiments (d) and (e) is now believed to be due to the presence of CO_2 excreted in the respiratory process of the organisms. Jennings has shown that they are attracted by weak concentrations of CO_2 and repelled by strong.² This fact greatly complicates and oftentimes vitiates experiments in chemotaxis with these animals.

Thigmotaxis. The stimulus offered by mere contact with a solid body is termed thigmotaxis. Animals that have a tendency to cling to, or to move along solid bodies are thigmotactic. Bits of sponge, linen, cotton, or cloth fibre, filter paper or bits of glass may be employed to demonstrate thigmotactic activities of *Paramecia*. These substances should be sterilized before using. The first gathering of *Paramecia* about such inert, insoluble bodies is thigmotaxis, but experiments (d) and (e)

¹ Jennings, H. S.: *Loc. cit.*, pp. 258-322.

² For a very satisfactory exposition of this subject, together with tests for detecting the presence of CO_2 , see the paper by Dr. Jennings already referred to. The same author has given an entirely new and far more satisfactory explanation of positive chemotaxis in a more recent study of *Paramecia*. See *Am. Jour. Phys.*, Vol. II, May, 1899.

under chemotaxis suggest that a continuation of the gathering in one place is due to the presence of CO_2 excreted. Dr. Jennings¹ concludes that "the reactions which play the chief part in the normal life of *Paramecia* are *negative geotaxis*, *positive thigmotaxis*, and *positive chemotaxis toward carbon dioxide*." This is very likely true and at first it might appear superfluous—at least for psychology—to investigate their reactions to any other kind of stimulation. Temperature, however, stands in such vital relations with life in general, necessitating through its frequent and wide variations, ever new adjustments, that it seems advisable to give a method of testing the reaction of *Paramecia* to temperature.

Thermotaxis. Mendelssohn² has demonstrated that *Paramecia* are negatively thermotactic to temperatures above and below $24^\circ\text{--}28^\circ\text{C}$, and are positively thermotactic to temperatures within and including these limits,³ i. e., $24^\circ\text{--}28^\circ\text{C}$ is their optimum.⁴

An apparatus yielding results quite satisfactory for demonstrational purposes may be constructed on the following plan: (1). A wooden frame—consisting of two uprights 16 inches long and 6 inches apart joined at the top by a cross beam and firmly joined to a wooden foot about 1 foot square; (2) a glass tube 6 inches long and $\frac{3}{8}$ inches in diameter with a $\frac{3}{8}$ inch hole at its middle point. Close the ends of the tube with cork stoppers containing a $\frac{3}{8}$ inch hole bored near the periphery. Insert the stoppers in the tube so that their holes will be as near the bottom of the tube as possible; (3) affix, transversely, on the inside of each upright, ten inches above the foot, a $\frac{1}{4}$ inch lead pipe one end of which carries a coil of two turns, of diameter barely sufficient to admit the glass tube.

The glass tube may also carry near its middle portion a movable pipe of one coil. Differences of temperature may now

¹Jennings, H. S.: *Loc. cit.*, p. 321.

²Mendelssohn, M.: *Archiv f. d. ges. Physiologie*, Vol. LX, pp. 1-27.

³His apparatus was simple and excellent. It consisted of a brass plate 20 cm. x 6 cm. and 4 mm. thick, supported in a horizontal plane. To its under surface was attached, transversely, tubes through which hot or cold water was run at pleasure from a reservoir elevated above the plane of the brass plate. In the middle of the plate a space 10 cm. x 2 cm. and 2 mm. was cut out and into which a glass or ebonite trough was fitted. Small thermometers with bulbs at right angles to their stems were placed in the plane of the trough and served to measure the temperature at any point. Desired differences of temperature between any two points along the trough were secured by means of water of different temperatures running through the transverse tubes.

⁴Thermotactic axis-orientation is a reaction to the stimulus created by the difference of temperature between the anterior and posterior ends of an organism. See discussions by Davenport and Mendelssohn.

be secured according to Mendelssohn's method (see note p. 406), or, if connection with hydrant faucets is possible, interpose between the faucets and the lead pipes two metal worms. By applying heat to one, and packing ice around the other, continuous streams of hot and cold water may be secured.

The following rough method readily shows the thermotaxis of *Paramecia*: Build a trough of wax on a glass slide $6\frac{1}{2} \times 1\frac{1}{4}$ inches. Fill the wax trough with "Paramecia water." Place the slide on two flat glass dishes juxtaposed. In one keep hot water, in the other ice. Let the hot water and ice barely touch the under surface of the glass slide. The movements of *Paramecia* may be followed with a hand lens.

(a). By means of geotaxis secure a large number of *Paramecia* in a small quantity of water. Pour into the glass tube "Paramecia water" until it barely covers the thermometer bulbs. Too much water will start up currents which impair the results. Find what temperatures attract and what repel *Paramecia*.

(b). Supposing that *Paramecia* migrate from a temperature 10°C to a temperature 18°C , and from temperature 32°C to temperature 26°C , make the further experimentation that is necessary to find their optimum.

(c). *Acclimatization*. Mendelssohn¹ found that, if *Paramecia* be kept in a temperature from 36° - 38°C from 4-6 hours, and then placed in a rectangular vessel whose end temperatures are 24° - 36°C respectively, they will occupy a position corresponding to 30° - 32°C . If, however, they are kept in a temperature 18°C and then placed in the vessel whose end temperatures are suddenly raised, they reach their optimum at 24°C .² Repeat this experiment. What inferences may be drawn from the facts of acclimatization?

HYDRA. (*Hydroidae*.)

These fresh water polypys belong to the primitive forms of double walled animals (coelenterata.) They (coelenterata) present to us for the first time organs and tissues composed of cells, and the *co-ordination* of different parts in the performance of certain activities, *e. g.*, simultaneous closing in of tentacles on some object of prey.

Fresh water hydra may be obtained by gathering from fresh pools Lemna, sticks, and grass and putting them into an aquarium. Hydras, which are attached to these objects, will then

¹ Mendelssohn, M.: *Loc. cit.*, pp. 19-20.

² Davenport, C. B.: *Loc. cit.*, 1899, pp. 27-32. See also Loew, O.: Ueber den verschiedenen Resistenz grad im Protoplasma. Archiv f. d. ges. Physiologie, 1885, Vol. XXXV, pp. 509-516.

usually migrate within a few days to the light side of the vessel. Hydras can be kept readily throughout the winter in a large glass jar containing *Lemna*, chara, water cress, and *Entomostraca* for food.¹

Touch. Place a Hydra in a watch-glass full of water. Touch the tentacle with a needle. What movements?

Selecting Food (Taste). (a). Drop cautiously and at intervals of a few minutes upon the surface of the water over the tentacles of the Hydra a drop of water, of sugar solution, of acid. What differences in the movements?

(b). Bring a *Daphnia* (previously stranded) on the end of a needle to the tentacles of the Hydra. Note the result. With another Hydra, use a bit of plant tissue.

*Reaction to Light (Photopathy).*² Place in a small glass jar full of water containing *Lemna* and *Entomostraca* two or three large, budding Hydras. Cover the jar with a box, placing the slit next to the window. Means of aeration should be supplied the glass jar. Note at short intervals for two weeks the position and number of Hydras in the jar.³

"Place a Hydra in a watch-glass with a little water, and by means of a needle and a penknife cut it into two or three pieces. Let the pieces expand and draw them. By means of a clean pipette place the pieces in a small Stender dish, in clean water. Draw the pieces again after 24 hours, and after a longer period if necessary."

EARTH WORMS. (*Lumbricus Agricola*.)

Worms changed the course of animal evolution from a radial to a bilateral form and established permanently the very fundamental principle of metamerism. Those that have migrated from water to land have, by reason of their crawling habits, greatly accentuated all those differences, begun in the sea, between ventral and dorsal parts, between anterior and posterior ends. These structural and physiological differentiations have an interest for the psychologist in that they express a correlation between the degree of sensitiveness and the relative use of the parts of an organism.

¹ For anatomical descriptions of Hydra see Manuals of Zoölogy.

² "The wandering of organisms into a more or less intensely illuminated region, the direction of locomotion being determined by a difference in intensity of illumination of the two poles of the organism, is photopathy." Davenport: *Experimental Morphology*. Part I, p. 180. See also Vitus Graber: *Grundlinien zur Erforschung des Helligkeits und Farbensinnes der Thiere*. pp. 318, Leipzig, 1884.

³ Wilson, Edmund B.: *The American Naturalist*, Vol. XXV, pp. 413-425, 1891. This paper of Prof. Wilson's contains also an account of Hydras reactions to colored light.

The nature¹ of the soil, as to its compactness, moisture, fertility, that is most favorable to the presence of earth worms; the shape and contents of their burrows; the relation of the amount of their castings to the changes of the weather—all must be studied out of doors in their natural habitat.

Sense Organs. Miss Langdon's² anatomical studies have demonstrated very thoroughly, "that the sense organs are distributed over the entire surface of the body, but are most numerous and largest at each end."³ It has also been found that the anterior and posterior portions of the body react to weaker solutions of strychnine and saccharine than do the middle portions.

Reactions to Chemicals. Apply very gently to different portions of the surface a few drops of strychnine varying in strength from 1:10000 to 1:100000; also solutions of different strengths, of saccharine and creosote.

Touch. Their sensitiveness to touch or a jar may be seen by tapping gently a vessel containing them. Blow the breath gently against the head end,—what effect?

Sight. Earth worms may be kept for an indefinite time in earthen jars containing rich soil. (a). Keep the entrance of their burrows illuminated all night, compare in the morning by weight the amount of castings with those of the previous morning. (b). Compare also the amount of food eaten with that of the previous night. (c). During the day expose (taking care to avoid jarring the vessel) the top of the vessel suddenly to the light—note how quickly the worms disappear beneath the surface when the light flashes on them. (d). Cover a pane of glass with moist filter paper, place a worm upon it and set the glass near a window—record the reactions of the worm. (e). Allow direct sunlight to fall upon the head end of the worm, the tail end, the middle. Make note of the reactions.

Food. Give at night three pieces each of the following vegetables—celery, potato, cabbage, apple and onion—all cut wedge shaped. Arrange the pieces of each vegetable, thus cut, in the form of a star, with their bases toward a common center. Note in the morning what pieces have been most eaten and the relative position of the pieces that have been

¹Darwin, Charles: *The Formation of Vegetable Mould through the Action of worms, with observations on their habits.* D. Appleton & Co., New York, 1885, pp. 326. This book should be read by every student of nature, not merely for the subject matter *per se*, but more particularly for the method and spirit that is so admirably brought to bear on a group of commonplace facts.

²Langdon, Fanny E.: *Am. Jour. of Morphology*, 1895, Vol. VI, p. 218.

³Lenhossek, Michael V.: *Ursprung, Verlauf und Endigung der sensibeln Nervenfasern bei Lumbricus.* *Arch. f. Micros. Anat.*, 1892, XXXIX, pp. 106-136.

disturbed. This should be repeated often enough to establish with certainty the presence or absence of a preference for certain foods.

Taste. Dip a piece of cabbage or celery into a strong solution of quinine and place it near a fresh piece of the same food, of same size and shape—notice whether the piece dipped in quinine is disturbed during the night.¹

*Smell.*² (a). Bring near to the head end of the worm in succession bits of sponges or filter paper saturated with water, with sugar solution, with onion juice, with acetic acid, and with beef extract. Does the worm react? (b). Bury in a hole about the size of a hen's egg a piece of onion. Pack the earth firmly, bury a second piece near by in a similar way, but do not pack the earth.³ Notice which is first disturbed.

Boring. (a). Place three or four worms in a pot of loose earth and note the time in which they disappear. (b). Press and pack the earth and repeat the experiment. (c). Try different kinds of soils—note where the worms go down. Do they swallow the earth while boring? Methods and rate of boring may be conveniently observed in tall narrow glass jars.⁴

Methods of Burying. (a). Place without order in a jar over night fifty dead pine needles. In another jar the same number of green pine needles. Note the next morning the arrangement of dead and green needles. (b). Make the same experiment during the day time—after covering the top of the jar with a black cloth. (c). Put dead pine needles in both jars; keep one jar in a temperature of about 22°C over night, and the other out doors uncovered. Compare the number of needles drawn in.

SLUGS. (*Limax Maximus.*)

This species of *gastropoda* may be found⁵ during the warmer seasons in gardens, orchards, dairy houses and the like, and during the winter seasons in greenhouses. They seek dark, shady, damp places.

¹Graber, Vitus: *Loc. cit.*, pp. 290-295.

²After Darwin's, probably no other work on the senses of earth worms is more helpful and suggestive than that of Nagel's. *Bibliotheca Zoologica*, Sept. 18, 1894, pp. 146-150.

³This experiment was used by Darwin to test the worms sense of smell. The food placed in the loose earth was usually found first. Might not this be partly due to the fact that the loose earth offered easier penetration to the worm?

⁴For the power of worms to regenerate lost parts see T. H. Morgan's paper in *Anat. Anz.* Bd. 25. No. 21, s. 407, 1899.

⁵I keep them alive all winter in a wooden box partly filled with rotten wood and rich soil taken from their natural habitat. They eat vegetables, fruits and meat.

Sense Organs:¹ Eyes, auditory vesicles (otocysts), tactile and olfactory organs are present.

Senses. They react to odors,² sound, touch, light, heat and gravity.

Sense of Smell.³ (a). Reactions to odors in the form of liquids may be secured by putting a band or stream of the solution on a pane of glass at right angles to the snail's line of motion. Do you find characteristic reactions toward different odors. Look for objectionable and unobjectionable odors; (b) note in seconds, in each case, the interval elapsing before the first responses.

Sight. (a). Do they discern objects?⁴ Weir⁵ is inclined to think that they do. "The snail carries its eyes in telescopic watch-towers . . . and, as semi-prominent and commanding view points are assigned to its organs of sight, one would naturally expect to find a comparatively high degree of development in them." His experimental test runs thus: At the end of a ten foot pole suspend, by means of a string, a white or black ball. The ball is made to describe a pendulum-like movement to and fro in front of the snail on a level with the tips of its horns. I suggest that a pane of glass be interposed between the snail and the swinging ball, thus preventing the possibility of creating disturbing air currents. (b). Put a specimen on a pane of glass 8 x 10, and place the glass horizontally near a window and let the slug be parallel to the window. Do not let direct sunlight fall upon it.⁶ Plot the position of the slug at intervals of ten seconds.⁷

Taste.⁸ Nagel⁹ believes that the lips and mouth parts of the slug are moderately susceptible to taste stimulus. By means of a pipette, place one at a time, and at right angles to the snail's line of motion, a band of distilled water, of a weak solution of sugar, of acetic acid, of quinine, of alcohol, of cheese-water, of meat juice, etc.,—make a record of its behavior on reaching the different bands of solution.

Locomotion. Place the slug on the glass and study its locomotion from the under side of the plate.

¹Claus and Sedgwick: Text-book of Zoölogy. 1884, Vol. II, p. 34.

²Spengel, J. W.: Die Geruchsorgane und das Nervensystem der Molluskin. Zeit. f. wiss. Zoöl., Vol. XXXIV.

³Nagel, Willibald A.: Bibliotheca Zoölogica, heft, 18, pp. 163-168, 1894.

⁴Lubbock, Sir John: Senses, Instincts, and Intelligence of Animals. p. 140.

⁵Weir, James: *Loc. cit.*, pp. 18-20.

⁶Hot water or a solution of ether and alcohol will cleanse the glass of the slime which should frequently be removed.

⁷Loeb, J.: Der Heliotropismus der Thiere. Würzburg, 1890, pp. 93-100.

⁸Lubbock, Sir John: *Loc. cit.*, p. 22.

⁹Nagel, W. A.: *Loc. cit.*, p. 164.

Geotactic Sense. A rough and ready demonstrational method is to place the slug on a pane of glass, parallel to one edge of the pane, hold the pane vertical and shield from lateral lights. Represent graphically the position of the slug at the beginning of the experiment, and at intervals of ten seconds, for about a minute.

The geotactic sense of the slug has been so well demonstrated by Davenport¹ that I can do no better than give his methods. A dark, wooden box of cubical form about 35 cm. in diameter, a dense, opaque, black cloth to cover the open side of the box which must be directed upwards, are required; a glass plate about 30 cm.² square carries the slug and is so placed in the dark box that one edge fits into one of the lower angles of the box while the opposite edge may be elevated to any degree ranging from 0° to 90°. Measure the angles off, upon one side of the box, and bore a hole at every fifth degree, so that the glass plate may rest on plugs inserted into the holes. The angular deviation of the axis of the body during a given time from the position in which it was first placed may be measured off by means of a protractor.

If the student desire to pursue the question of geotaxis further, he may investigate to answer the following questions, which may readily be determined by experimentation. (a). "What relation exists between a variation in the pressure of gravity and the precision of orientation?" (b). "What is the limiting pressure which will call forth the geotactic response?"³

The former is demonstrated by ascertaining the angular deviation of the slug from a vertical position upon the plate at various inclinations from 0° to 90°, and after the lapse of a constant time (45 seconds). The data gained in answer to the first problem furnishes an answer to the second.

Preliminary to (a): Ascertain whether the *quickness* of the response of the slug is modified by the strength of the action of gravity, *i. e.*, does the slug respond as quickly and effect as complete an orientation at say 15° as at 75°? For this purpose, place the slug on the glass so that its long axis is parallel to the lower edge of the plate. Set the glass successively at 60°, 45°, 30°, 20° and 15°, and make five tests at each angle upon one and the same slug. Two time intervals should be taken: (1) the time elapsing before the first response to gravity occurs, and (2) the interval required for

¹ Davenport, C. B.: Jour. Phys., Vol. XXII, pp. 99-110, 1897-98.

² I receive satisfactory results from a box 10 x 8 x 7 inches deep.

³ In addition to these questions, Dr. Davenport asks a third: What determines the position of the head end? A solution of this question involves experimentation beyond what is contemplated in this course.

the organism to place its entire axis in a vertical position. To avoid exposing the slug to the action of light during the preliminary experiment, the completeness of orientation should be observed after different periods of time, *e. g.*, at the end of 30, 40, and 50 seconds. That period in which orientation is just effected should be the time selected for future experiments.

(a). Set the plate at the following angles: 90° , 60° , 45° , 30° , 20° , 10° and 0° . At each angle make six determinations on each one of five slugs. For each angle find the mean of the thirty determinations of the angular deviation of the slug from the vertical position, (b) note the extreme deviations from the vertical in the case of each slug.¹

FISH.

A study of fishes in the interests of comparative psychology is exceedingly desirable, for the reason that they stand at the bottom of the great back-boned series of animal life presenting in a simple and fundamental form all the essential structures characteristic of that group. To the fish we owe a debt for having encased the nervous system in a bony vertebral column, for developing an efficient neuro-motor mechanism operating about a stiff longitudinal axis, and for having "staked out" or laid down the ground plan of the nervous system on which the forces of evolution have erected the complex structures of higher forms.

The following are some of the fish suitable for such a study; pickerel² (*Esox Americana*), perch (*Perca Americana*), goldfish (*Cyprinus Auratus*), horned pout, common bull head (*Ameiurus nebulosus*) and shiners and spotted tail minnows (*Notropis hudsonius*) and stickle-back (*Eucalia inconstans*). Both pickerel and perch should be kept in large aquaria supplied with a continuous flow of water—a forced stream is preferable. Chara, water cress, or other water grasses should be supplied and, of course, permitted to *grow*. Shiners, earth worms, newts, young frogs serve as food. Gold fish do not require constant running water. It should be changed, however, every week or two. Supply the aquaria with sand and pebbles, and grasses—like water cress, cabomba, chara.

Food for gold fish may be had of the dealers.

Food. (a) Feed regularly—daily or every other day depend-

¹ See also Geotaxis by Davenport, Experimental Morphology, Part I, p. 119.

² The scientific names of North American fishes can be found in U. S. Com. of Fish and Fisheries, report of 1895, pp. 209-590. This work was prepared by President David Starr Jordan and Dr. B. W. Evermann.

ing on the species and somewhat on the season. Note the time required for the different species to recognize your approach and presence.¹ Do some never learn to recognize you? (b). Compare the manner in which, *e. g.*, perch² and pickerel seize their food (live minnows). Can you account for the difference? (c). See if you can detect a carnivorous fish stalking its prey. (d). Cut the rice wafer preparation for gold fish into pieces about 1 cm. square. Give the fish, along with the two or three pieces of wafer, a piece of decided yellow paper cut like the wafer in size and shape. Note carefully the results. Repeat the experiment often enough to justify a conclusion. Next give them paper of a much lighter yellow and observe their behavior toward it. Is it touch or taste or both that acquaints them with the paper? Finally, give them cut pieces of white filter paper, which very closely resembles the rice wafer. At each experiment do not give more than two or three bits of rice wafer with the one piece of paper. It would be of great interest to find out if the gold fish would ever learn not to strike at the white filter paper. (e). Feed³ perch on shiners for three months, then partition off a portion of their aquarium with a pane of glass. Every other day, at the feeding hour, put shiners in the new division. Note on each occasion the number of attempts made by the perch to catch the minnows. Remove the minnows from the tank at the end of each observation. Feed the perch earth worms on days not experimenting. Should the perch finally become indifferent toward the minnows, remove the glass partition. Note the effect. (f). Some fish, like pickerel, appear to have "table manners," others, like sticklebacks, snatch at times the food from each other's mouths as do the hens.

*Temperature.*⁴ The sensitiveness⁵ of fish to temperature varies greatly among different species. (a). If a minnow be transferred from a temperature of about 20°C to 2°-4°C, and allowed to remain ½ minute, it will soon appear as dead. If,

¹ McIntosh, W. C.: Note on the Memory of Fishes. *Journal of Mental Science*, Vol. XLIV, pp. 231-235, 1898.

² Neither pickerel nor perch eat dead fish.

³ This experiment was suggested by the famous experiment of Möbius on pike. The story runs that pike, having lived for some time in a tank separated by a glass plate from another in which small fish were living finally desisted from trying to catch them, and on the glass plate being removed made no attempt to molest the small fish. See interpretation by Prof. Bateson. *Journal of Marine Biological Association*, pp. 243, 1890.

⁴ For an account of some experimentation and observation on the Sense-Organs and Perceptions of Fishes, see W. Bateson in *Journal of Marine Biological Association*, Vol. I, pp. 239-248.

⁵ Goode, G. Brown: U. S. Fish Com. Report, 1877, pp. 51-72.

after a minute, it be transferred successively through 10°C, 15°C, and back to 20°C, life returns;—transferring directly from 2° to 20°C often kills the fish.

(b)¹ The following apparatus may be used not only for testing their sensitiveness to temperature, but also for finding their optimum. (I suggest that the test be made with shiners, using



20 or 30 at a time). A zinc trough about 20 cm. deep, 16 cm. wide and 2.4 meters long supported by a wooden frame. [See cut.] Solder to the bottom of the trough 16 cm. from one end a tin box 12 cm. wide, 15 cm. long and 6 cm. deep. The box receives water through a hole cut in the zinc trough. Solder a stand-pipe to the zinc trough about the hole leading to the tin box. Apply heat to the tin box. The water in the trough should not exceed 2½ inches in depth. The end opposite the tin box should rest on iced sawdust. Ice may be applied to the sides of the trough, and also put in the water to secure desired differences of temperature. Lay lengthwise of the trough a strip of board containing ¼ inch holes about six inches apart. Thrust thermometers through the holes and into the water two inches below its surface.

*Sight.*² Observations³ made on different species readily show that there are wide differences in their range of vision, e. g., perch appear to recognize the human figure about 30 feet away, minnows 20 to 25 feet away and pickerel 10 to 15 feet.

With the room darkened and with a magic lantern mounted

¹ An apparatus of this sort gave satisfactory results in searching for the optimum temperature of tadpoles. See *Am. Jour. of Psychology*, 1898, Vol X, No. 1, pp. 8-10.

² Bateson, W.: *Loc. cit.*, pp. 242-248.

³ One may connect with observations on the sight of fishes experiments and observations on their color changes. The horned pout is said to alter its color when transferred from a white to a dark dish. Abbott and others cite cases of color changes during emotional excitement. The different hues on my perch are more pronounced after an exciting chase for a minnow. It appears that changes in the intensity of light causes apparent changes in color.

on a rotating table placed about three feet from the aquarium, throw a bright light on the aquarium in the region of the fish. Should the fish finally move away or just out of the zone of light, rotate the table until the light covers his entire body. See if, by repeating this process, you can drive them back and forth between the ends of the aquarium. It would be interesting to see if they react toward colored light as toward white. Bateson found no appreciable difference in the reaction toward white and colored light among the species tested by him.¹ Give to a species of day feeders food at night,—note their behavior by means of a dark lantern.

Hearing. Ichthyologists² are generally agreed that fish do not hear sounds transmitted by air waves.³ The ear apparatus is usually interpreted as an organ for equilibration. They do respond to vibratile motions imparted to the water by solid bodies. Some fish are known to make noises, and even musical sounds which are heard by other fishes of their kind. Would acuteness of hearing be of any advantage to the fish?

Emotions. The works of Romanes, Brehm, Günther, Darwin, Abbott and others cite instances of the activities of fish that are expressive of fear, pugnacity, social, sexual and parental feelings, anger, jealousy, play and curiosity. How many of these emotions do you notice?⁴

CHICKS.

"I have now described, perhaps in undue detail, a few of my observations as noted down at the time. To some they may seem trivial, and scarcely worth the making and the noting. To us, as students of comparative psychology, their interest lies in the light they throw on the beginnings of psychical life and activity in the chick or duck."—*Morgan*.

¹ Bateson, W.: *Loc. cit.*, pp. 251-252.

² Lee, F. S.: A Study of the Sense of Equilibrium in Fishes. *Jour. of Physiology*, Vol. XV, pp. 311-348.

³ Kreidl, Alois: Ueber die Schallperception der Fische. *Archiv f. d. ges. Physiology*, 1895, Vol. LXI, pp. 450-464; also Ein weiterer Versuch über das angebliche Hören eines Glockenzeichens durch die Fische. *Archiv f. d. ges. Physiologie*, 1896, Vol. LXIII, pp. 581-586.

⁴ From my observations on shiners, I am persuaded that they, at least, possess the capacity for feigning death. Pickerel will not eat dead fish—at any rate mine do not. Sometimes they are not successful at the first two or three attempts in seizing a shiner. These unsuccessful attempts greatly excite the small fish, which dart hither and thither pursued by the pickerel. The chase may finally be given up or the pickerel may seize one, after which all becomes quiet. It is at this period that the lucky shiner seeks a dark place and lies flat on one side as when dead. I have been deceived several times myself when, on going to remove them from the tank, thinking they were dead, they would dart with lightning speed to some new quarter.

The fact that chicks can be reared under test conditions and by the care of foster-parents, makes it possible to see more clearly just what responses are due to inheritance, *e. g.*, pecking, cuddling, making their toilet; and what are due to sense-experience, operating under the principles of association, *e. g.*, responses to agreeable and disagreeable foods.

*First Day. Senses*¹. (a). While peeping in the shell,² whistle,³ clap the hands near the egg, hold a tuning-fork near—is there a response to these sounds?

(b). After they have recovered from the "catastrophe of birth," repeat the sounds made in (a) and others that suggest themselves. Repeat this at ages 12, 24, 36, and 48⁴ hours, respectively, and note the differences in responses both as to the increasing perfection of the sense of hearing and in the expression of the emotions.

(c). Has tapping on the floor near the food with a pencil any suggestive⁵ value—through the auditory sense—to the chicks pecking?

2. Note behavior toward different odors, *e. g.*, spearmint, iodoform, cologne, cheese, asafoetida, etc. Odors may conveniently be presented on bits of cotton batting held by forceps.

3. At about the age of 12 hours test the field of vision by dropping bright bits of shell or meal before them. Move the food back and forth, up and down, before them. Do they peck at food beyond their reach?⁶ Is it necessary to touch the eye to get a winking reflex?

4. Touch their feet with cold, medium, and quite warm wire—note the response in each case. Note fondness for sunshine.

Instinctive Movements.⁷ (a). Note efforts to stand,⁸ to walk⁹ follow moving objects¹⁰—do they show preferences here? Note position of head and neck when sitting. Whenever possible early movements of other birds should be noted and

¹ Suggestions and directions for hatching chicks by means of an incubator may be had by writing to any reputable manufacturer of incubators.

² Morgan, C. Lloyd: *Habit and Instinct*, 1896, pp. 31-32.

³ Hudson, W. H.: *Naturalist in La Plata*, 1892, pp. 99.

⁴ Spalding, D. A.: *Instinct*. Macmillan's Magazine, Feb., 1873, Vol. XXVII.

⁵ Darwin, Charles: *Expression of the Emotions*, 1872, p. 47.

⁶ Preyer, W.: *The Mind of the Child*, p. 239. Translated by H. W. Brown, 1888.

⁷ Preyer, W.: *Loc. cit.*

⁸ Morgan, C. Lloyd: *Habit and Instinct*. Chapter 3.

⁹ Mills, Wesley: *The Nature and Development of Animal Intelligence*.

¹⁰ Groos, Karl: *The Play of Animals*. Chapter 3.

compared with those of chicks, *e. g.*, standing, walking, and swimming of the duck. (b). Make a list of all those activities that may be regarded as instinctive, *i. e.*, "congenitally perfect," as pecking, cuddling (do they show a preference here or do they cuddle indifferently under any object)? Do loud, sharp sounds shock or frighten them?

Voice. How many distinct sounds can be distinguished at this age?

Second Day. 1. Repeat experiments on the senses, adding to the list experiments on taste by giving them bits of lemon and orange¹ peelings, or a bit of blotting paper of pronounced color saturated with quinine. Note with special care the increased perfection of sight and hearing.

2. Note all activities of food getting, such as pecking, seizing, bill-movements, swallowing, etc. Offer them water (water should not be offered earlier than the second day), and observe just how they come to drink. Offer them an earth worm, beetle, or the like, and note the effects of competition. Imitative² acts are liable to occur at the end of the second and the beginning of the third day. For discovery³ and accurate description they require careful observation.⁴ What is the nature of the activities imitated, racial or acquired?

3. Observe the following: (a) certain activities fading out, (b) new ones appearing,⁵ *e. g.*, preening feathers, flapping wings, wallowing, scratching—will they scratch on a bare surface, or do they require a bit of sand or grain to touch off the scratching apparatus? these may not occur until third and fourth days. (c) Are there any which they do from individual experience?

*Memory and Associations.*⁶ To study the formation of associations in the chick the sense of taste may easily be employed. Offer them some bitter or disagreeable substance of a pronounced color as food. The number of experiences which the chick has with the disagreeable substance before it avoids or neglects it altogether is a rough measure of the time required for a permanent association to be formed between the color of the food and its disagreeable effects when taken into the mouth⁷

¹ Hunt, H. E.: *Am. Jour. of Psychology*, 1897, Vol. IX, pp. 125-127.

² Morgan, C. Lloyd: *Loc. cit.*, pp. 166-185.

³ Romanes: *Mental Evolution in Animals*, pp. 222-223.

⁴ For imitative movements in the child, see Preyer: *The Senses and the Will*. Tr. by H. W. Brown. pp. 282-292.

⁵ James, W.: *Psychology*, Vol. II, pp. 394-402. See Transitoriness of Instincts.

⁶ Thorndike, E. L.: *Animal Intelligence*. *Supp. Psy. Rev.*, 1898, pp. 65-78.

⁷ Morgan, C. Lloyd: *Introduction to Comparative Psychology*, 1894. Chapter 5, Association of Ideas in Animals.

An experiment of this sort may require several successive days of observation. The permanency of the association should be tested by offering the objectionable substance several days apart.¹

Third Day. Instinctive Activities. Note the first appearance of attempts to scratch the head, to wallow, to play, and under what conditions these things occur.

Emotions. Joy, fear, anger may be expressed at this age.

Solitude and Society. The effect of solitude may be observed by isolating one chick completely from his kind—not even letting it hear the voices of other chicks. Feed it on a limited variety of diet. At the end of four or five² days, introduce it to a flock that have enjoyed society and a larger variety of experience. Observe its initiation into this larger world.

The above outline, covering the first three days of chick life, and indicating the kind of observations to be made for the advantage of psychology may be continued with profit twelve to fourteen days, the duration depending largely upon the problems set for the chicks to do.

THE WHITE RAT.

"No ghost story or tale of horrid murder has been considered quite complete without its rat peering from some dark corner."—*Cram*.

To Mr. Willard S. Small I am greatly indebted for both the form and matter of this section. The outline here presented by Mr. Small for studying this rodent is based on his own very painstaking investigations, which have extended over nearly two years. With appropriate variations—dictated of course by the instincts, dominant traits, etc., of the rodent to be studied, the outline may serve for further investigations on other members of that family.

The white rat presents some modifications of the psychical character of his wild congeners,³ but these are comparatively slight. The description given by Brehm⁴ of the character of *mus decumanus* applies to the domesticated white rat with almost equal accuracy. The principal difference in psychic outfit is the inferiority of vision in the white rat. The eye is unpigmented and seems to be a much less important instrument than with the wild varieties.⁵

On account of their early maturity, healthiness (under nor-

¹ Kline, L. W.: *Am. Jour. of Psychology*, Vol. X, p. 273.

² *Ibid.*, pp. 271-272.

³ Brehm: *Thierleben* (Säugethiere, Vol. II, p. 342 ff.). A characterization of the species *Muridae*.

⁴ Brehm: *Loc. cit.*, p. 349.

⁵ Rodwell, James: *The Rat* (London: Routledge and Sons) is a mine of anecdotal literature upon the rat,

mal conditions¹), gentleness and cleanliness white rats are well adapted for experimental studies.

1. *The Psychic Development of the Young Rat.* The white rat, born blind and deaf, passes through two distinct phases of psychic development:² the period before, and the period after, sight and hearing begin to function. The method in this section is to follow the development of the animal's psychical activities from birth until the age of five or six weeks. The only factor appearing after this age is the sex instinct. This appears about the ninth or tenth week.

SENSATION.³ *First day.* 1. *Smell.* Test⁴ with several substances, *e. g.*, fresh milk, cologne water, hydrochloric acid. Observe: (a) the character of the reactions—how many kinds? (b) whether the reactions seem to indicate pleasure or displeasure in each case; (c) can you distinguish between the act of sensing and the motor reaction? (d) do you distinguish the vibratory movements of the nostrils so characteristic of the rodents?

2. *Taste.* Open the mouth and place upon the tongue: fresh milk, honey or sugar solution, aloes or quinine solution, or other substances. Observe: (a) the reactions; (b) whether they seem to indicate discrimination of tastes.⁵

3. *Tactile Sensibility.* (a) Touch the skin lightly on various parts of the body; (b) draw a bristle across the back, flank or side, and over the nose; (c) pinch very lightly the tail, foot, and sides or flank; (d) touch any part with a cold wire (32°), and then with a hot wire (not hot enough to burn); (e) notice also the rats' extreme sensitiveness to changes of atmospheric

¹ The following conditions should be observed: (1) the rats must be kept in a warm room—temperature not lower than 50° F.; (2) the floors of the cages should be covered one inch deep with clean sawdust; this should be changed at least once a week; (3) the cages should be so arranged as to protect the rats from strong light; (4) a simple diet of dog biscuit and milk and occasional green stuff, *e. g.*, apples or lettuce, gives good results. Fresh water each day. Offensive odors are minimized by carefully observing (2) and (4).

An excellent observation cage may be made as follows: dimensions, length, 20 inches; height, 16 inches; width, 16 inches; floor, back, and top of wood; one end of wire mesh ($\frac{1}{4}$ inch) for ventilation; front and other end of glass. This insures observation of all activities, and is large enough for the introduction of necessary apparatus.

² Mills, Wesley: *Animal Intelligence*, p. 167.

³ In connection with the observations upon sensation, it will prove interesting and suggestive to note the conditions of the sense organs.

⁴ Bits of paper held by forceps are convenient for this purpose. The odorous substance should be held from 2 to 5 mm. from the nostrils. Other odors and irritating fluids should be used. For similar tests upon other rodents, cf. Mills, W.: *Loc. cit.*, p. 234, 241. Distinguish carefully between the effects of odors and irritating fluids.

⁵ Mills, Wesley: *Loc. cit.*

temperature as indicated by rapid lowering of bodily temperature and retardation of heart-beat when brought from the nest into a cooler atmosphere; (f) observe also their apparent satisfaction when covered with the hand.

4. "*Sense of Support.*"¹ Place the young rat near the edge of the table, and note whether it crawls off or hesitates at the edge and shows uneasiness.²

5. *Sense of Position.*³ Place the rat upon a pane of glass in horizontal position, with the sagittal axis of body parallel with two sides of the pane; then tip the pane—each end and side in turn—and note the angle required to elicit a response, *i. e.*, an effort to compensate the inclination of the pane.

*Second to fifteenth day.*⁴ Follow the same line of observation, noting these more general points.⁵

1. *Smell.* (a). The tests may be made with the same substances, or variations may be introduced. In the former case, note the effect of growing familiarity upon the reactions; (b) note whether there is any diminution in the time required for sensing the stimulus; and (c) distinguish between sensing of stimulus and motor response.

2. *Taste.*⁶ The experiments need not be repeated more than twice during the first week; after that, every second day.

3. *Instinctive Activities.*⁷ *First day.* 1. When the young rats are held in the hand, observe their tendency to roll up into a ball. 2. Place them upon a smooth table and observe their efforts;⁸ (a) to stand, (b) to crawl, (c) to hold up and move the head from side to side; (d) observe further whether they seek to get together; explain the reason of this movement and consider whether it has any significance for

¹Mills, Wesley: *Animal Intelligence*, pp. 118, 150, 176, 225. Morgan, C. Lloyd: *Habit and Instinct*, p. 107.

²This experiment *may* be impracticable the first day on account of the limited locomotion of the rats.

³Sanford, E. C.: *Experimental Psychology*, p. 36. Lee, F. S.: *Jour. of Physiology*, Vols. XV and XVII.

⁴Weigh the rat and measure length of body and head from time to time.

⁵Mills, W.: *Loc. cit.* Prof. Mills's work should be familiar. The differences brought out in his studies, between young animals of different species, are most instructive. Preyer, W.: *The Mind of the Child—the Senses and Will.* (Tr. by H. W. Brown.) p. 257 ff.

⁶The experiments on taste and smell may be varied profitably by introducing the factors of hunger and satiety. Compare rats taken at random from the nest with some that have been segregated for two to four hours, according to age. (N. B. Keep them warm.)

⁷Morgan, C. Lloyd: *Habit and Instincts*. Ch. 5. For a discussion of "Instinct," cf. Ch. 1. Also Groos, Karl: *The Play of Animals*. Marshall, H. R.: *Instinct and Reason* (MacMillan, 1898). James, W.: *Psychology*, Vol. II, Ch. 24.

⁸For comparison with other rodents, cf. Mills, W.: *Loc. cit.*

the origin of the "social instinct." 3. Turn them over upon their backs; note their efforts to turn over upon their bellies; note also the variety of movements in these efforts and the lack of muscular co-ordination.

4. Try to observe the sucking activity from the first.¹ (a) Do the new-born rats find the mother's teats immediately by a "congenitally perfect instinct," or is there accident in the process? (b). Do they suck any other part of the mother than the teats? (c). Does the mother render assistance?

5. Test their clinging power—letting them cling, unsupported, to your finger.² The attempt should be made constantly to infer the sensational and affective states correlative with the instinctive activities.

6. *Vocal Expressions.* Note carefully the number of sounds you can distinguish clearly, and what affective states they severally indicate.³

The eyes and ears begin to function about the fifteenth day. Between the second and the fifteenth days, two facts of a general nature relating to motor activities should be noted: (a) the increasing vigor of movements, and (b) definiteness of muscular co-ordination. Note especially, the progressively effective use of the paws in sucking.

In respect to vocal activities, it should be noted whether they increase in variety, and whether they are indulged in more or less frequently.

New features in development may be looked for as follows :

About the seventh day, note that they begin to move about more freely, selecting their paths to some extent and avoiding obstacles.

Tenth to thirteenth day. 1. Look for the appearance of some very characteristic "rat" activities: (a) orientation, by rising slightly upon the hind legs and sniffing about, when they are moved into a new place; (b) climbing up on the mother's back and up the side of the cage; (c) scratching the body with the hind foot;⁴ (d) washing the face with the fore paws. 2. Observe about this time also that they may leave the nest and follow the mother in order to suck.⁵

¹Mills, W.: *Loc. cit.*, p. 118 ff. Morgan, C. L.: *Loc. cit.*, p. 113. Hudson, W. H.: *The Naturalist in La Plata*, p. 106. Wallace, A. R.: *Contributions to the Theory of Natural Selection*, p. 206. Preyer, W.: *The Senses and Will*, p. 257.

²Robinson, Dr. Louis: *Nineteenth Century*, Nov., 1891. (This instinct in the human child.)

³Contrast with rabbit, Mills, W.: *Animal Intelligence*, p. 134.

⁴This is called by Romanes a pure reflex. Cf. Romanes, G. J., *Darwin and after Darwin*, part 2, p. 80.

⁵I have seen one leave the nest and go directly to the mother, a foot away, eating her supper. Whether this was by chance or by smell is an interesting question.

A test for instinctive fear may be made by rubbing a cat and then presenting the hand to the nostril of the rats.¹

At the end of the first period, it will be well to "take account of stock," summarizing the psychical elements that have now appeared, noting their time of appearance—congenital or later—and their order of development.

SECOND PERIOD.

The following suggestions for this period may serve for a general outline, to be varied or discontinued at discretion.

SENSATION. 1. *Smell.* Tests should be made now especially with food substances, *e. g.*, milk, cheese, honey, meat, etc. Tests may be made also with essential oils.²

2. *Test.* Discrimination of taste, by putting edible and non-edible substances into the mouths of the rats, *e. g.*, dog biscuit and sealing wag.

3. *Hearing.*³ (a). Tests should be made for hearing just before the external meatus is completely open, by clapping the hands, clucking, hissing, whistling, etc. Be careful that a current of air is not thrown upon the rats with explosive noises. (b). Generally the sense of hearing becomes acute about the fifteenth day. (c). Try a number and variety of sounds, especially musical tones (a gamut of tuning forks is desirable). Also introduce variations in loudness.

In these experiments observe the small variety in the reactions at first. What is the inference?

(d). The test should be repeated daily for a few days noting the progress in discrimination of sounds and the emotional concomitants. (e). At the age of about three weeks, test for æsthetic sense in connection with sound.⁴ An air played softly upon a violin or even sung softly will serve for test.

4. *Vision.*⁵ Make tests as soon as the eyes begin to open. (a). Bring the rats into a strong light. (b). Strike the hand across the field of vision an inch or two in front of the eyes.

¹ Mills, W.: *Loc. cit.*, p. 176, 177. (I have not been able to confirm Prof. Mills's experiment with respect to rats. Cf. Morgan, C. L.: *Loc. cit.*, p. 117.)

² "Rats are enticed by certain essential oils." Darwin: *Descent of Man*, p. 530.

³ Mills, W.: *Loc. cit.*

⁴ Anecdotes of rats and mice being fascinated by music are so frequent and so well authenticated that this experiment is of peculiar interest. Cf. Weir, Dr. James: *The Dawn of Reason*, p. 116.

⁵ It should be remembered that vision is the least efficient of the white rat's senses. A comparison should be made between the importance of vision and the importance of smell and hearing in the development of the young rats.

What effect in each case? Can you get a winking reflex without touching the eyes?

The experiment upon vision will probably be unprofitable after four or five days, except experiments for the determination of the distance at which the rats can see objects. These may be made at intervals as long as the study continues. These determinations may be made roughly by moving an unfamiliar object in front of the cage, carefully excluding all sound.

5. Observations of the common activities of the rats will yield information in regard to tactual and kinæsthetic sensations, and the sense of equilibrium.

INSTINCTIVE ACTIVITIES. After the eyes and ears are open, observe the gradual disappearance of some activities, the progressive perfection of others, and the appearance of still others.

A. *Vocal.* Even casual observations will show the diminution of vocal activity.

B. *Motor.* 1. Note the slow degeneration of the sucking instinct. 2. Orientation, climbing and washing are rapidly perfected. 3. New activities appear, 17th to 21st days. (a). Gnawing. They nibble at one's fingers, at food, and as early as the 21st day I have seen them gnawing a stick. (b). Digging. (c). Play activities—running, jumping, mock fighting, etc. They may frequently be seen licking each other. It is not apparent whether this is in play or whether they are searching for vermin.

At the end of four or five weeks the student should again "take account of stock" and catalogue the psychic outfit of his subjects. As all our knowledge of the animal mind is inferential, the same observations will serve as basis for conclusions as to instinct, general intelligence and emotion in the rat. For example, the constant investigations of the waking rat will declare his curiosity. The eager expectancy displayed at the usual feeding time,¹ especially when they hear the rattle of the food, is evidence of memory. Fear is apparent at every unusual noise.

¹Rats should be fed in the afternoon.

II.

SUGGESTIONS FOR EXPERIMENTAL STUDY OF INTELLIGENCE.

The preceding study of the young rats will have brought out the rat character sufficiently to warrant the setting of a good many tasks. For example: hunger, sociability, and curiosity may safely be appealed to as motives for the performance of tasks; climbing, digging, and gnawing are patently instinctive and persistent activities.¹

Two practical suggestions for apparatus are appended. In each case aptness for learning, imitation, and memory may be tested. The rats should be at least six or seven weeks old.

1. The apparatus consists merely of an ordinary squirrel revolver. A revolver 10 inches in diameter and one foot long can be used in the cage described above, and it is better to perform the experiments in their accustomed place.

(a). Keeping the door of the revolver open, note the time required for the rats to learn to run the revolver.²

(b). After the rats have learned this lesson, a test of imitation may be made by introducing one or two uninitiated rats into the cage. The difference in time required to learn the lesson may be taken as a rough measure of imitation.

(c). Furthermore memory may be tested by removing the drum for a time and noting the results upon its return.

This experiment may be variously complicated. For example, after the rats have learned to run the revolver, the door-way may be closed with a spring door such as is described in connection with the next piece of apparatus.³

2. Two pieces of apparatus. In both cases the motive appealed to is hunger. The activity in one case is digging; in the other, gnawing.

(a). Exp. box 1. A box⁴ 7 inches square and 6 inches high; sides of wire mesh, $\frac{1}{4}$ inch mesh; top, glass; bottom, wood. At one side of bottom, a hole $3\frac{1}{2}$ by 2 inches is cut. Two strips of wood $1\frac{1}{2}$ inches thick tacked to the bottom raise the box above the floor of the cage. Sand and sawdust are banked about the box just above the level of the floor. Food

¹This enumeration is merely a suggestion; it is not intended to cover the field.

²Other interesting things will be observed: *e. g.*, if there is any straw or litter in the cage, they are very likely to carry it into the revolver and make their nest there.

³In all these experiments the experimenter must be prepared for individual variations.

⁴The apparatus and the method is more fully described by Dr. L. W. Kline, *Am. Jour. Psychology*, Vol. X, No. 2, p. 277. The diary of a few days' experimentation is given.

of some kind¹ is placed in the box and the top fastened down. At the usual feeding time, Exp. box 1 is placed in the cage and banked up as described. There is nothing to mark the place of entrance. This experiment should be repeated daily till the lesson is completely learned, so that the rats go at once to the right place and dig into the box.²

(b). Exp. box 2. The same as Exp. box 1, except that the floor is solid and the entrance is on one side. The entrance is an opening, $2\frac{1}{2}$ inches square. This opening is provided with an inward swinging door of sheet zinc, hung from the top. The door is attached by a spring³ (an ordinary rubber band) to the top of the cage, so that when free it is held open. The door is held closed by means of narrow strips of stout paper stuck, with sealing wax, to the door and the lower edge of the box. Admission to the food within can be attained only by biting, pulling or scratching off the paper. This experiment, too, should be repeated daily until the habit of getting the food by removing the papers is formed.

The two experiments yield the same results in regard to the determination of instinct, intelligence, and habit.⁴ The two should be carried on contemporaneously with two pairs of rats. Some interesting comparisons will in the form of discrimination be apparent.

A further study of intelligence may be made, after the two pairs have mastered their lessons, by interchanging the boxes.

After this new task has been performed, the problem may be complicated still more by alternating the boxes at unequal intervals. If it is desired to test even further the adaptability of the rat, other complications or variations may be devised.

Careful analysis of these experiments will reveal the parts played by the different psychic elements: the instinct feeling of hunger (and curiosity too, perhaps,), the instinctive activities employed, recognition, memory—these all combining to form complex associations.

THE CAT.

"The cat seems to be a much more intelligent animal than is often supposed."—*Mivart*.

"Indeed no greater contrast in table manners can be observed anywhere than when we turn from the kennel or the pig sty and watch the dainty way in which a cat takes its meals."—*Robinson*.

"In will-power, and ability to maintain an independent existence the cat is superior to the dog."—*Mills*.

¹ I use nothing but dog biscuit. The rats must not be over fed.

² Not more than two rats should be set to this task at once.

³ A small hook soldered to the lower part of the door serves to attach the spring to the door.

⁴ Kline, L. W.: *Loc. cit.*, p. 279.

A psychological study of the cat,¹ or allied species, will be more profitable and certainly more pleasant to both student and cat if the former bears in mind the dominant cat traits: She is independent of man from a vegetative standpoint; self-willed, will not brook restraint; she is slow to forget an injury and often resents it; enjoys kind treatment; she is for the most part solitary in her habits.

The senses, instinctive activities, the emotions, the formation of habits, and the growth of intelligence constitute the essential material for observation and investigation.

The *order* in which the senses develop, and likewise the order and the conditions under which the instinctive movements and the expression of the emotions occur, should first engage the attention, and that, too, not later than the second day.²

Sense of Smell. Cheese, meat, warm milk, the hands after being rubbed over a dog, after handling mice, carbolic acid, etc., may be presented as objects of smell. Can you distinguish between the act of sensing and the motor reactions?

Sense of Taste. Solutions of sugar, salt, and aloes may be applied to the tongue by means of a feather or camel's hair brush. Milk, vinegar, and meat juice may be similarly applied.

Touch. Reaction to the sense of touch may be solicited by touching the sole of the forepaw, the mouth, inner surface of the nostrils and the ear with a broom straw, or knitting needle.

Temperature. Heat an iron rod to an uncomfortable degree to the human skin (not hot enough to burn) and place it against the sole of the kitten's foot.

Pain. Pinch different parts with forceps or fingers—note the *latent* time before the response. Does the latent time shorten with age?

*Sense of Support.*³ (a). Uneasiness manifested by cries, and gripping the supporting surface vigorously with its claws, when it crawls to the edge of the same, is interpreted as a response to a disturbance of the sense of support.⁴ If convenient make the same experiment with a turtle, a puppy, an ant, a slug, a chick. (b). Place the kitten on a board 12 x 14

¹ Brehm: *Thierleben* (Säugethiere, Vol. I, pp. 461-480.); J. Hampden Porter's *Wild Beasts*, pp. 76, 305, contains many significant observations on the habits and traits of *Felidæ*.

² Prof. Wesley Mills is the first scientist to have observed daily the psychic development of the cat from birth to maturity. Many of the above suggestions are founded on Prof. Mills's work. See also Bernard Perez: *Mes Deux Chats*; *Fragment de Psychologie Comparée*, pp. 39-78. Paris, 1881.

³ See literature under Rat.

⁴ Prof. Mills says: "This seems to me as fundamental as anything that is to be found in animal psychology."

inches, the sagittal axis coinciding with the length of the board. Tip the board slowly by raising one side until the kitten perceives the new position. Tip the forward end in the same way, then the rear end—note the angle that the board makes with the horizon in each of the positions.¹

Reactions to Rotation. Place the kitten on a small rotation table—head toward the periphery. Turn the table at a moderate rate through one rotation—note the direction of the first movement after the table stops.

*Hissing.*² This mode of expressing a certain group of emotions is natural only to the *Felidae*, *Reptilia*, and a few birds. What stimulus provoked the first hissing sound. How many kinds of hissing sounds can you detect in the kitten? Note the same points with regard to spitting.

*Tail and Ear Movements.*³ The movements of these pendant organs are for the most part instinctive, though in the case of the ear they would seem to be more of the nature of a reflex. Their *quivering* motion is a curious phenomenon.

Sight. Eyes open about eighth day—note shape, color, the distance at which objects are recognized, when the kitten first follows a moving object by turning the head and by rolling the eyes.

Special directions for observation and experimentation on the kitten after the tenth day are not only useless but a positive hindrance. No two observers are likely to surround the young cat with the same environment and conditions; therefore, in the matters of habit and intelligence, each place will have its own special problems. But the appearance of instincts and emotions peculiar to the cat will occur under all favorable conditions, so that it may be helpful to indicate what to expect or look for as the psychic life of the cat unfolds. Look then for the *first* appearance of spitting, hissing, making its toilet,⁴ playing with inanimate objects,⁵ chasing moving objects, stretching and yawning, especially after a nap or leaving its nest, enjoying being stroked, setting claws into upright objects, tree-climbing, purring, crouching, "lying in wait," bowing the back in rage, playing "with real living prey," *e. g.*, a mouse,⁶ playing "with living mock prey,"⁷ *e. g.*, its mother or another

¹ "(b)" is not an experiment to test the sense of support, but rather that of "position."

² For a probable origin of hissing and tail wagging, see Louis Robinson, "Wild Traits in Tame Animals." London, 1897, pp. 228-264.

³ Ingersoll, E.: *Wild Neighbors*. See chap. "The service of Tails."

⁴ Robinson, Louis: *Loc. cit.*, pp. 262-264.

⁵ Robinson, Louis: *Loc. cit.*, pp. 228-229.

⁶ Groos, Karl: *The Play of Animals*, pp. 121 and 130.

⁷ Mills, Wesley: *Loc. cit.*, p. 196.

kitten. How many of these activities can you account for? What is their significance in the economy of cat life? A study in the formation of associations and their consequent habits, may most naturally begin (a) by observing the kitten in learning its name. Make a record of the number of times the name is uttered until it is recognized by the kitten. While teaching it, the name should be used judiciously, and always in immediate connection with a pleasurable reward, *e. g.*, food, stroking, giving it a play object to which it has become attached.

(b). Select from among its play activities, one that the cat may be readily induced to repeat (this the observer must decide), then create conditions that will call forth a second one that has a pleasure giving or satisfying effect. Note the number of times necessary to create the new condition that shall call forth the second act without hesitation. The following account of an actual case will illustrate the point. After the young cat had become accustomed to play with a ball, a long string was attached to the ball by which it was withdrawn gently from the cat and dropped into a work-basket. The cat saw the whole performance and immediately took the ball from the basket and continued the play for a few minutes when the ball was jerked away and dropped into the basket with the quickest possible despatch. After two experiences, *i. e.*, at the third time the ball was jerked away, the cat went directly to the basket. The experiment may be varied—basket moved before the ball is jerked into it, a different basket used, etc.

Under this head would come teaching¹ some of the well known

¹ A radically different method for studying associative processes from those given in (a) and (b) has been used by Dr. Thorndike. (Thorndike, E. L.: *Animal Intelligence*, p. 6. New York, 1898.) "It was merely to put animals when hungry in enclosure from which they could escape by some simple act, such as pulling at a loop of cord, pressing a lever, or stepping on a platform. . . . The animal was put in the enclosure, food was left outside in sight, and his actions observed. Besides recording his general behavior, special notice was taken of how he succeeded in doing the necessary act, and a record was kept of the time that he was in the box before performing the successful pull, or clawing, or bite. This was repeated until the animal had formed a perfect association between the sense impression of the interior of that box and the impulse leading to the successful movement." I recommend that the food be put *in the box* and the animal on the *outside*, free, unhampered, and that the several tasks set by Dr. Thorndike for the animal to do in order to escape be accordingly transferred to the outside of the boxes. I have found this method to work admirably well with the white rat, and the cat. See *Am. Jour. of Psychology*, 1899, Vol. X, pp. 277-279. The time required to perform each experiment, and particularly just how it is done, and whether or not experience facilitates the execution of the task, are among the essential items to be noted.

tricks, *e. g.*, rolling over, jumping through the hands, "begging" in upright position, shaking hands, etc.

Full notes are always valuable. While teaching them a task, the notes should be made as near as possible *at the time* of the experiment. It is highly important, too, that every circumstance attending the cat's first successful effort in doing a set task be carefully noted. If convenient, photographs should be taken; and especially of attitudes expressive of emotions that are usually so difficult to describe.

THE EFFECTS OF MIND ON BODY AS EVIDENCED BY FAITH CURES.¹

By HENRY H. GODDARD, A. M., Fellow in Psychology,
Clark University.

Our remedies oft in ourselves do lie,
Which we ascribe to heaven.

—*Shakespeare.*

Perhaps no question is forcing itself upon the attention of society, concerning which there is so little knowledge and so much prejudice, as the question of the value and rights, of the new methods of treating disease, included under the comprehensive term,—“Faith Cure.”

In some one of its forms it is making its appearance on all sides. The medical man has it to contend with: he finds a patient has left him to try a mental practitioner; or else he is called to treat a new patient upon whom “mind cure” has failed. The legal profession has occasionally to decide whether the mental healer is guilty of mal-practice, or the friends and relatives of a deceased person guilty of “culpable neglect” because they trusted to some form of mental therapeutics and did not consult the recognized doctors of medicine. The minister meets it as a more or less persistent theological doctrine, which he must either uphold or denounce. Finally, no person can see a friend enduring a lingering illness, unbenefited by the arts of the physician, without having this new method urged upon him, and without having at least the beginnings of a query in his own mind as to whether there is “anything in it” or not. And if the friend who looks on, how much more does the sick one himself, wearing out the weary hours of suffering, watching the weeks grow into months and the months into years, with no improvement, wonder if, since everything else has failed, it may not be worth while to try the prayer cure or hypnotism or Christian Science.

Whenever one of these people in any one of these different classes attempts to find a basis for a rational conclusion, or facts

¹In this paper we have attempted to present a brief survey of the field, that portion of the data which is of most psychological interest, and some of the conclusions, from an extended study of mental therapeutics. We hope to present in a later publication an extended report of all the work referred to.

to help him to a wise decision, he invariably finds such a confusion that, as a rule, he gives up in despair.

Mind cure suggests psychology, and the psychologist is appealed to for the laws of mind which may explain the phenomena and give the rationale of the question. But the psychologist is silent; or at most can only say: "The relation of mind to body is unknown to us, and in the nature of things will probably never be determined."

It is the method of the "New Psychology," however, to collect all the facts possible, in relation to such questions, in the belief that, in time, these facts which at first are so isolated as to be without any apparent relation, may eventually be so numerous and so complete that they will fit into each other, and exhibit a more or less perfect picture.

It is believed, that even if this study yields no new relations in psychology, it at least puts together facts that may sometime be of value to the psychologist, and will at once appeal to all who are interested in the practical side of ameliorating human ills.

In the following pages, we propose to give a brief account of the principal forms under which the practice of treating disease without drugs, appears; next to show the relation of these to each other; and finally select one—the so-called Mental Science—for a fuller treatment. This will be followed by such explanation as we are able to give by correlating it with more scientific practices in the same line; concluding with a little speculation on some of the deeper problems suggested by the facts presented.

We have alluded to "Faith Cure" practices as among the *new* methods of treating diseases. As a matter of fact the principle is as old as human history, and only certain claims and certain methods of applying it are new. Of these new forms probably the most pretentious as well as the best known is Christian Science. The school of "Healers" known as Christian Scientists, own allegiance to, and claim as the discoverer of the practice, Mary Baker Glover Patterson Eddy. The book which contains the doctrines of the sect is believed to have been written by Mrs. Eddy under divine inspiration.

Mary Morse Baker was born in Bow, N. H., July 21, 1821. Her father was of Scotch descent. As a child, Mary was sickly and hysterical; not able to attend school much and consequently received very little education. December 12, 1843, she married George W. Glover, an architect, of Wilmington, N. C. Mr. Glover died suddenly of cholera in May, 1844. One child—a boy—resulted from this marriage. After about fourteen years she married Dr. Patterson, a dentist, of Franklin, N. H. He was a man of excellent character, and did everything possible for his wife. In 1862, Mrs. Patterson went to Portland

to be treated by Dr. Quimby's mental methods of curing disease. In 1865 she obtained a divorce from Patterson. Her first publication was copyrighted in 1870, and she published "Science and Health" in 1875. In 1877, she married Asa Eddy, of Lynn, Mass. In 1879, she organized a "mind healing church," of which she became pastor in 1881. She also established her "Metaphysical College" in 1881. Her husband, and also her adopted son, Foster Eddy, assisted her in the college. Mr. Eddy died suddenly in 1882. In 1889, she closed her college, and since then has devoted herself to the advancement of Christian Science theories through her writings. The growth of the organization has been rapid and large. Mrs. Eddy now resides in Concord, N. H., and is seldom seen even by her most devoted followers. "Science and Health" is in its 160th edition, and her other writings have passed through many editions.

These writings, particularly "Science and Health," contain the authoritative creed of the organization, the foundation of their theory and practice. The teaching is a sort of absolute idealism. Mind is divine; mind is all. Sin and sickness are delusions of "mortal mind." The "treatment" consists in the assertion that sickness is not a reality but only a "belief." The acceptance of this view by the patient is the cure sought for.

The following account, received from a Christian Scientist healer, in answer to our syllabus, will probably give as clear an idea of the philosophy, theory, and practice of Christian Science, as it would be possible for us to give in the space at our disposal.

I suppose the object in sending me these questions to answer is to learn the character of Christian Science method or principle of healing; and so the answers take up the subject as viewed from that standpoint. If you find them unintelligible or unsatisfactory, it is because of the wide difference between the bases of methods built up from a material, mental or bodily cause, and a wholly metaphysical being.

Please relate the facts connected with the cure of any physical ailment, without medicine. Mention in same way any disease prevented in similar manner.

The facts as revealed by a study of Christian Science, show that the only agency ever effective in curing disease, is some faculty of mind; that matter having no potency in and of itself, it follows that the exercise of mental belief, ascribing certain degrees, qualifications and results, either to the drug or material process, is what restores the patient. But suppositional faith, basing its reasoning on the evidence of one or more of the physical senses, is unreliable, since it can only reason uncertainly from effect to cause; causation thus being an unproven hypothesis, liable to be found only another effect on deeper investigation.

Christian Science shows such reasoning to be useless, since not understanding how the phenomena of disease is dissipated, the patient

is liable to recurrence in the same or another form, and is unable to prevent or to cure himself.

Christian Science starts with a demonstrable fact for its causation, found in a self-evident, self-existent Principle of Mind, and reaches an understood and knowable cure through its application in a scientific process.

What was the nature of your malady?

It had none. Disorganization is not an entity to be characterized.

How long had you been afflicted with it?

Ever since the belief that disease was a substantial entity, instead of a negation.

How did you first discover that you were a victim of disease? Give fully your symptoms.

By a consciousness of limitation, i. e., finiteness.

How did the idea come to you that you could be healed? If suggested by some person, what was your estimate of that person?

The conviction that limitation was an error, as shown by the inability and suffering it brought; and that it was right to be well; and sickness was a wrong.

Suggested by a sense of justice.

Was your cure instantaneous?

Yes.

If so, how did you know that you were cured?

By the instant receding of disease; and the corresponding increasing of health and strength.

Did you know it at the time, or not until later?

At the time; since mind first perceiving the truth, its objective manifestation begins to appear.

Did you have to test it, before becoming convinced that a cure had actually taken place?

No; it brought its own self-evident proof with it.

If not instantaneous, how rapid was it? How do you know that it was any more than a natural recovery?

It was natural recovery. There is no other genuine recovery, since health (omipotent and self-existent intelligence), when left to itself, without any erroneous interference, will do its own work naturally.

Was there any new feeling in the diseased part at time of recovery, or in any part of the body? If so, describe and explain what you thought it meant.

No. The disappearance of sensation left the body free to respond to any use the mind would have for it.

Since the more intense the sensation, the more powerless the organ to act harmoniously; it follows that the theory that matter is conscious intelligence, is a causative error, expressing itself in disease. Christian Science proves this true, for, by correcting this mistaken theory, the afflicted organ is relieved, and becomes free to be adapted to any action the mind may demand of it.

Have you ever doubted your complete cure, or had a relapse? If so, give reasons for your first doubt, or the occasion of your first realizing that you were not permanently cured? To what do you attribute the relapse? To what your cure?

No. A principle is a complete whole, hence can manifest nothing less. Any appearance of relapse or failure comes from lack of principle. 1st, to the fact that mind creates all phenomena. 2nd. That the instant a fact is seen to be true, all previous theories, regardless of age or sup-

posed substantiality, disappear as realities from that mind. 3rd. That the phenomena of the theoretical conception also vanishes with it, since effect cannot exist without its cause.

If you have ever tried to get healed by any of these methods, and failed, relate the circumstances.

Failure followed every effort to find health, until Christian Science was understood and demonstrated. Allopathy, homeopathy, hygiene, rational systems, surgery, sanitarium treatments, mind cure, will-power, all failed.

To what do you attribute your failure?

To a mistaken belief that the eternal mind-principle of health was a material condition; that it could be lost and re-created by some material mechanism, and was dependent upon physical conditions for its existence and manifestation.

Please answer the following questions relating to your own personality, with great care. Age? Temperament? Disposition? Complexion? Married? Do you now, or did you as a child, choose or avoid responsibility? Did you, or do you, prefer solitude or companions? Were you precocious, backward or normal, in the matter of learning to write, walk or talk? What was your health in childhood?

This paragraph is unanswerable from Christian Science basis, since it deals with mentality only, and recognizes physicality as the manifestation of mistaken, changing, human belief; having no fixed character of its own, and subject to constant correction.

If you were healed in answer to prayer, kindly describe the circumstances, and answer the following questions in addition to the above.

If by prayer is meant a petition to set aside fixed law and its penalties to please some favored petitioner, decidedly, no. If it means a humble, steadfast desire for spiritual, mental, and bodily wholeness, recognized as a God-given right to all, to be received in proportion to man's intelligent understanding of the God-nature and its operation; yes.

What had been your religious experience previous to your cure?

I found nothing in popular religions or philosophies of any practical value.

What was your idea of the efficacy of prayer?

It had none beyond a blind faith in the petitioner, resulting in a manifestation of self-mesmerism.

How did the faith that you could be cured, first come to you?

Realizing the fact that disease was discord, led me to seek every means possible to find the harmony which is health.

State any doubts that you had.

Neither doubts nor certainties; as it was simply another experiment.

What plan had you formulated, or what conditions did you expect to have to fulfill before you could be healed?

Obedience to any requirement; as would be expected in giving a fair trial to any system.

Did it happen as you had planned, or did you change your views of the matter? If the latter, how did you come to change your views?

The positive proof of the disappearance of disease, left no room for questioning the presence of health or the success of the means employed.

Was the final result in any way contrary to your expectations? If so, how?

I had no expectations.

What physical sensations, if any, accompanied your restoration?

None whatever.

Had you any previous conception as to how the cure might take place?

No.

What was your mental and religious state at the time of the cure?

Having been a student of various philosophies and material sciences, both mental and religious conditions were the essence of materialism.

Did you seem to have any "revelation," or was there any "manifestation," as of "angels" or "flames" or "voices," or any such thing?

Not the slightest.

Was it comparable to any of the cures wrought by Jesus, or any other case of which you had heard or read?

It was comparable to the cures wrought by Jesus, in that as we who are healed in Christian Science to-day, so with the people of those days; after "suffering many things of many physicians," found disease not lessened and often increased; turned as a last resort to the Master Healer. In like manner, by the same demonstrable principle which Christian Science finds He worked by, the sick are healed to-day.

What effect has your cure had upon your religious life?

My cure, study, and demonstrations of Christian Science, prove to me the existence of a practical, scientific theology, whose principle demonstrates itself to be true, in its power over sin, sickness, death, and all discordant conditions in material environment.

It proves the Sermon on the Mount, and the Kingdom of Heaven on Earth, to be present possible standards for humanity to live by, in proportion as each one accepts the standard and obeys the rules which Christian Science shows to be the way to gain this harmony of Infinite love.

If you were healed through the influence or mediation of some person or "healer," or "hypnotizer," kindly describe the appearance and character.

The healing of Christian Science is not through any influence or mediation of a healer.

The patient goes to a so-called healer, through a mistaken idea that the healer possesses some ability or understanding which he has not. Like an elder brother, the so-called healer corrects this mistake, as well as others, through mental processes, until the patient's mind is in a condition to be corrected audibly, and shown how the work is done directly for himself.

Any seeming failure in cures arises from lack of adherence to its principle, either in patient, healer, or both.

Please mention any books bearing on these subjects that you regard as good.

The only text-book of genuine unadulterated Christian Science is "Science and Health, with Key to the Scriptures," by Rev. Mary Baker G. Eddy. Published in Boston.

We will add one more.

DEAR SIR: I cannot send you returns. To a student of Christian Science there is no psychology, for there is but one soul even as there is but one God. God is soul. Man reflects soul, for man is "made in the image of God," but soul is not in man; the less cannot contain the greater. And whereas before I was healed from chronic invalidism through the "teachings of Christian Science" I used to think much on your topics, I wish never to think or refer to them again; cannot and be consistent or obedient to the teaching which heals. They are mental poison to me.

May I please express a wish for you and all that are making a "scientific study," all who are seeking for knowledge—a wish that you and they might be induced to study the Bible in the light of "Science and Health with Key to the Scriptures," by Mary Baker G. Eddy.

Yours in truth,

Christian Science is an offshoot from another school which we shall term Mental Science—a term quite generally used by those who practice this form. Mental Science may be said to have originated about the middle of this century through the efforts of P. P. Quimby.

It differs from Christian Science in that it acknowledges no allegiance to any one man, and does not claim to be a special revelation from God, but seeks the basis for its theory in the teachings of the old philosophers or modern mystics, and especially empirically in the results of its practice in the realm of therapeutics. It has not the explicit religious form of Christian Science. It is a philosophy, a theory of life. We give a fuller account of its theory and practice in a later portion of this paper.

Another form of curing disease without medicine is the so-called Divine Healing. Under the general idea that God heals disease in answer to the prayer of faith, we find many variations in the method, or rather the ceremonies accompanying it, and some little disagreement as to the strict theology of the process. But since they all produce results, it may be assumed that the differences do not go further than the minds of the healers, and that the real principle lies deeper than individual theories.

Of course it goes without saying that the whole practice is based upon the Bible, and the differences are the result of differences in interpretation. One division anoints with oil according to the suggestion of the Apostle James. Another heals by the laying on of hands, according to the practice of the other Apostles. While a third set discards all types and formalities and simply prays for the afflicted one. It is generally agreed by all, that the result is according to the faith of the sick one, and the fact that any particular prayer is not answered is evidence that the patient did not have sufficient faith. There are, however, those who argue that it may be the will of God that a person should endure sickness, and by such, a resignation to the will of God is encouraged.

Rev. A. B. Simpson, of New York City, is one of the leaders in this work. His teaching is peculiar in that he argues that when once a person has prayed for healing it is dishonoring God to doubt the cure or to ask for a sign or symptom. The person must claim he is healed and expect it. This accounts

for the many people who claim to be healed but whose appearance contradicts their words.

Many oppose this view and hold that it is claiming a lie to assert that one is healed when he is not. The chief opponent, and the most pretentious healer is the Rev. John Alexander Dowie, of Chicago.

A brief account of Dr. Dowie, will not be out of place here. And fortunately we can give it in his own words as published in his own *Leaves of Healing*, for Dec. 11, 1896. It gives not only the facts of his life but his style, method, and manner of preaching (for this is part of the report of his sermon), and his general character.

He says :

I will give you a little of my autobiography, and I am not ashamed of what God has wrought.

I was born in Edinburgh nearly 50 years ago.

Next May 25 I will be 50 years of age.

I earned my own bread from my 14th year, and was brought up in the academies of Edinburgh.

I went with my father, who is on this platform, to Australia.

I plunged into business, and within a few years was the resident partner's confidential clerk in a firm doing \$2,000,000 in open goods, every invoice of all these imports passing through my hands.

Soon after that I became the financial manager with a partnership interest, small then but larger to come, in another firm ; and though I say it, I do not boast of it, I had the confidence before I was 21 years of age of men in the largest lines of business, and was myself handling large concerns.

At that age I consecrated myself to the ministry, and my money, hardly earned, and my time. With my father's co-operation I studied privately and then returned to my native city, Edinburgh, in the University of which I studied for some time.

I have the honor, therefore, of being a Scotchman trained in academical, in business, and in University life, and when I returned to Australia my brethen in the Congregational body within three short years gave me the honor of placing me at the head of possibly the most important charge in the entire denominational body—famous for its big heads, some people think, and, after all, there is something in those heads, too.

I was the pastor of the Newtown, Sydney, Congregational Church, which gave me the opportunity of ministering to the professors and students of Camden College, the only Theological Seminary of the Congregational Churches in Australia, which brought me into close touch with many of the ablest men in the great University of Sidney, a city of more than

half a million people. That was my third pastorate, and I held it when I laid down my denominational connection to give my life to a world-wide work for God and for humanity.

I had the honor of being at that time the leader—so Sir Alfred Stephens, the Lieutenant-Governor and Chief Justice for 29 years called me in a public meeting,—the leader of the Social Reform Party.

I was offered by Sir Henry Parks the portfolio of Minister of Education in his government, and I could have been, he said, Premier within a few years, if I had only given myself to politics.

I helped to mould public opinion, and helped to create legislation in my own land, and was frequently chosen to do important public work.

For instance, the Liberals of Sydney once appointed me, in company with Sir Henry Parks and the Editor of a Sydney daily paper, to draw up an important document addressed to the Right Hon. W. E. Gladstone. This document was one of great importance at a time when the foreign policy of the Tory party under Benjamin Disraeli, Earl of Beaconsfield, had strained the loyalty of Australia to the mother country.

On another occasion I was supported by the Protestant ministers of all denominations in Sydney in answering a famous address of Archbishop Roger Bede Vaughan, and when my address appeared in pamphlet form, it brought me kind commendation from the late Mark Pattison, Master of Lincoln College, Oxford, and from Mr. Gladstone himself. The largest hall in Sydney was filled to overflowing with the leading men of the land when this lecture was delivered, and it was the first gun fired in a battle against Roman Catholic supremacy in educational matters, the final result of which was the taking away of all grants to denominations from the public treasury and the establishment of a National Compulsory, and Free Educational System for all the people.

I am also the General Overseer of the Christian Catholic Church, which has tens of thousands of sympathizing friends in and around Chicago, and we have set down at our monthly Communion with nearly 2,000 communicants at one time in the auditorium.

I am the editor, proprietor, printer and publisher of "Leaves of Healing," a weekly paper with thousands of subscribers in all parts of the world, and God is blessing our little White Dove, of which we have no reason to be ashamed.

My position entitles me to courtesy, and the recognition of my ministry.

Beside Dr. Simpson and Dr. Dowie there are many local

leaders in this work whose methods differ slightly from those already mentioned. There is also a class of "travelling healers" who go about from place to place, each with his own claims to power, and with his own methods. Three of these may be mentioned, as the types and forerunners of what bids fair to become a distinct guild—that of the tramp healers. These are Schlatter, Schrader, and Bradley Newell. The first two, "Divine Healers," the last, "Magnetic."

Schrader and Newell are too well known through the daily press to need description here.

A brief biography of Schlatter will illustrate the type when sincere.

The career of Francis Schlatter is a most unique bit of biography. A native of Alsace, France, a shoemaker by trade, he came to America in 1884; spent some years in New York; went to Denver in 1892. In his youth he attended school until 14; but all his life he was a reader, student, and thinker. In 1893, at the age of 37, he became possessed of the idea that God—"Father" as he always familiarly called him,—wanted him to go forth from Denver on foot. He obeyed, and during the following two years walked through Colorado, Kansas, Indian Territory, Texas, New Mexico, Arizona, California, and back to New Mexico. On this journey he endured untold privations and hardships, from hunger, thirst, heat, cold, and unkind treatment. But he "had to" do it; and always obeyed "Father" at whatever cost. "Father" often told him to go without food for days at a time, and often allowed him water only on alternate days. He was imprisoned as insane at two different times. His own account of his wandering is interesting though somewhat monotonous reading.

He was well read on the great moral, religious, and social problems, and discussed them with a good deal of ability. He was possessed of the idea that he was Christ, and explicitly declared it on a few occasions; though as a general thing he talked and acted without any apparent idea of such an impersonation. Only his appearance, dress, hair, etc., were strikingly suggestive of the mediæval pictures of Christ.

His discussions were strongly marked by two ideas—reincarnation, and socialism.

Whatever conclusion one reaches as to his real nature and condition, no one can doubt the sincerity of the man. He honestly thought himself called to do a great work for "Father," and he devoted himself to it with all his energy, and with that childlike faith which produced surprising results. One can but regret that his ideas only led to his untimely death.

Following these, as another species of mental therapeutics, we may mention hypnotism. The treatment of disease by

hypnotism is avowedly a matter of suggestion. While extensive in its use and application, it is yet confessedly limited. Practiced by a large number of regular physicians, some of them of world-wide reputation, the cases number many thousands and constitute some of the most valuable sort of data. We shall revert to this more at length later.

The following account taken from Bernheim (*Suggestive Therapeutics*, p. 363,) will illustrate his method :

M., 27. Married, delicate constitution, nervous temperament, suffering from severe intercapular pain. Pressure in the region causes severe pain. I propose to hypnotize him by closing the eyes. He gives himself up to it with a bad grace. He is very impressionable and fears that I wish to perform an operation on him. I reassure him, and continue *suggestion*, holding his eyes closed. His nervous anxiety is with difficulty dissipated. His hands tremble. However, he goes into *profound sleep*; there is relaxation without catalepsy, and no memory upon waking. I energetically suggest calmness of mind; I affirm that the pain has disappeared.

Having let him sleep alone for about six minutes, he has several nervous spasms and calls out: "I am falling!" and then awakens as if coming out of a nightmare. He remembers having dreamed that he was falling into a ditch. *The pain has almost completely disappeared*; he is surprised; cannot find the sore spots. *I hypnotize him a second time*. He gives himself up easily. His sleep is more quiet; there are slight nervous movements in his hands. I suggest the complete disappearance of the pain. Upon waking he remembers having heard talking but does not know what I said. . . . There is not the slightest pain. He does not understand it; his astonishment has something comical about it.

Such is Bernheim's own account, slightly abridged, of one case. Of course it must be understood, that, as in regular practice, no two cases are treated just alike.

Besides these four distinct schools of curing disease without drugs, there are many minor forms in which the same element is to be seen, though not usually so considered. Among these may be mentioned Patent Medicines in so far as they cure "incurable diseases" or produce results out of proportion to the known therapeutic value of the drugs constituting the compound. Especially is this seen in the great number of patent "devices" for the cure of disease, such as "electric" belts, bandages and garments of all sorts, also the various inhalers.

A striking device, remarkable for the cures it has wrought, as well as for the absolute freedom from anything curative except its name, might be designated as a string one end of which is fastened to the ankle of the patient, while the other end is tied to a tin can which is then immersed in a dish of water or buried in the ground. Again we have no end of "health fads," each producing its long list of testimonials, in the shape of cures of more or less serious diseases, but which again reduce in the last analysis, to the effect of the mind of the patient

upon his own body. "Home remedies" also contain many instances of the same thing, and they in turn are the survivals in the present time of the older customs which characterized the age when nearly all therapeutics was a science of magic.

In the study, of which the present paper presents a portion, all of these phases have been investigated extensively. Folklore literature has been ransacked for all that it could furnish in regard to practices, superstitious and otherwise, relating to therapeutics. The "fads" of modern times have been collected; the household remedies still in vogue have added their testimony; patent medicines and devices have been examined as to their actual medicinal value, and the results they produce. Their testimonials have been examined and verified.

We have studied with the hypnotist, seen him at work and learned his art. Hundreds of cases treated by hypnotism have been studied and tabulated. The divine healer has been observed in many instances and particularly in the persons of Schrader, whose blessing we received on two occasions, and Dowie, whose work we visited and whose method we studied in his "Divine healing home" in Chicago.

As a basis for study of Divine Healing, we have over 1,600 records of individual cures, all of more or less value and completeness.

The cases to be discussed are nearly all from Dr. Dowie's work. About two-thirds of them are females. In age they range from 6 mos. to 86 yrs. though the main part of them are between 20 and 50. Of the women, the married are about three times as numerous as the unmarried.

The duration of the disease from which they were healed, varies from a few minutes to fifty-two years. The average time is about twelve years for each sex. Thirty-three per cent. report their healing instantaneous, fifty per cent. gradual and seventeen per cent. say they are not yet perfectly healed. It must be noted that while thirty-three per cent. report instantaneous healing, it is clear from their own account that they almost always mean that pain ceased instantly. And it may be mentioned here that of all the returns that give data on that point, almost every one shows that pain ceased at the time of prayer.

Again, of the whole number seventy-six per cent. were treated, or prayed with, by Dr. Dowie in person, seven and one-half per cent. were prayed for by him at a distance. Four and one-half per cent. were prayed for by Mrs. Dowie. Seven and one-half per cent. were healed in answer to *their own* prayers or efforts and four and one-half per cent. were healed in answer to prayers of friends.

The number of ailments mentioned in their accounts of

themselves, varies from 1 to 9 for the males, and 1 to 11 for the females.

The time that has elapsed since the cure varies from a few days to fourteen years. Time required for full recovery may be as much as two months. If longer than that it seems to be regarded as a failure and is not mentioned.

As to diseases cured they have been classified roughly as follows: the figures are per cents.

DISEASES.

	Nervous.	Circulation.	Respiration.	Digest.	Contagious.	Wounds.	Cancer.	Rheumatism.
Males.	20	10	20	15	5	14	5	11
Females.	22	14.5	18	16	5	3.5	11.5	9.5

Among the remarkable features mentioned may be noted the following: Legs lengthened from 1 to 5 inches. "Gained 95 lbs." Hip $2\frac{1}{2}$ inches reduced. 56 abscesses at one time, cured. Deaf and dumb. Senseless 3 weeks. While the men report: "40 whiskies a day," cured. "Wreck physically." Hip disease. Goitre. 3 Bullets. Deaf and dumb. Fever settled in bones. Appendicitis. Leg shortened 2 inches. Born blind. Deaf after measles.

These were jotted down as the reports were read, simply as an indication of the range of the work. In the reports of women the term "Internal troubles" is often mentioned. From the context it appears that the expression generally refers to troubles peculiar to that sex. In other cases such troubles are directly specified.

The following is a list of the "Troubles" as stated by the patients themselves:

Abscess; accident; ague; appendicitis; ankle sprained; asthma; backache; back weak; bad habits; bilious trouble; blindness; blind from birth; blood poisoning; Bright's disease; bronchitis; bronchial disease; broken arm; burns; burnt hands; blood disease; brain fever; cancer; cancer in tongue; cancerous tumor; carbuncle; catarrh; chills; cholera infantum; cholera morbus; congestion of lungs; consumption; constipation; convulsions; cough; chlorasis; compound curvature of spine; croup; deafness; deaf and dumb; diabetes; diarrhoea; diphtheria; dislocated shoulder; dislocated knee; dropsy; dysentery; dyspepsia; diphtheretic paralysis; devil cast out; earache; eczema; epilepsy; erysipelas; eyes, inflammation of; eyes, weak; eyes, sight failing; feeble minded child; fever; fever sores; felon; fistula; gangrene; gambling; goitre; granulated eyelids; gall stone; headache; healed when dying; heart disease; heart broken; heel lame; hay fever; hydatids; hydrophobia; hemorrhage of lungs; hemorrhage of kidneys; hemorrhoids; her-

nia; hip broken; hip disease; hip joint renewed; hysteria; imperfect sight; infidelity; impediment of speech; impotent; indigestion; inflammation of bowels; inflammation of stomach; inflammation of lungs; inflammatory rheumatism; internal tumor; ivy poison; internal troubles; intestinal trouble; insanity; kidney and bladder; knee, injured; knee, stiff; knee, swelling in; la grippe; lame; leg too long; leg too short; leg, poisoned; leucæmia; liver trouble; locomotor ataxia; lung trouble; lung fever; lumbago; malaria; measles; meningitis; morphine habit; mumps; nearsightedness; nervous exhaustion; nervous prostration; nervous trouble; neuralgia; nervous debility; ovarian tumor; palsy; paralysis; periostitis; piles; pneumonia; poly-pus; puerperal convulsions; peritonitis; pleurisy; paralysis of bowels; palpitation of heart; quinsy; rheumatism; running sore; rib broken; rupture; salt rheum; scalding; scarlet fever; scrofula; skin eruption; skull fractures; sick headache; spasms; sea sickness; sleeplessness; small pox; spinal meningitis; sore throat; spinal disease; spine, curvature of; sciatica; stone cancer; stigmatism; stiff hip joint; stomach trouble; sunstroke; synovitis; symmetrical keratiasis of the palms and soles; tape-worm; throat trouble; tobacco; toothache; tonsilitis; tuberculosis; telegrapher's paralysis; tuberculosis of bowels; tumor; tumor fibroid; thigh bone diseased; typhoid fever; ulcers; urinary trouble; ulcers in bowels; varicose ulcer; varicose veins; whiskey; wounds; wrist sprained; weak lungs; weak eyes; white diphtheria; wild hairs; whooping cough; yellow fever.

The unfortunate Schlatter has been followed, by his own written testimony, and that of his personal friends, through his work as a healer and his wanderings alone until his death from starvation in the deserts of the Southwest, a victim to a peculiar form of delusional insanity manifesting itself in religiosity.

Cures at shrines such as Lourdes, and by means of sacred relics have contributed their lessons.

Christian Science has unwillingly yielded its facts and philosophy to our work. By means of many personal interviews with Christian Science healers, people who had been healed and those upon whom the method had failed, and by a faithful perusal of "Science and Health," together with a careful study of the life of Mrs. Eddy from childhood, a clear view of the whole system has been obtained. A study of cases similar to those under divine healing has also been made.

Lastly, Mental Science has received its share of attention and yielded perhaps the best returns. Mental Science healers have been uniformly courteous and helpful, ready to furnish records of their cures and often of their failures, willing to

discuss their theories and admit their limitations. The literature of this as well as of the other schools has been read.

The result of this investigation, extending over more than two years, is an absolute conviction based upon evidence, only one or two items of which we can give here, that the curative principle in every one of the forms is found in the influence of the mind of the patient on his body. In other words, however different the claims and the method, the explanation of all is the same. We may mention a few of the items leading to this conclusion. They all cure disease and they all have failures. They all cure the same kind of diseases and the same diseases are incurable for them all. In those classes of disease where the cures are wrought, there are the same percentages of cures by all the methods. Stripped from a few characteristic phrases all the reports from all the different forms are identical. A testimonial to a patent medicine, for example, reads precisely like one of Dowie's reports of a divine healing cure. Again there are many records of people going from one school to another and in this no one practice seems to show any advantage. Some fail after trying all. Some fail to get cured by divine healing, but get restored by Christian Science, and *vice versa*. Others fail with Christian Science and are successful in hypnotism, and *vice versa*.

In view of this unity of principle, we have selected for special presentation here, the two forms of Mental Science and Hypnotism as typical of the whole matter. Mental Science gives the best expression of the popular philosophy in this line, while Hypnotism gives the scientist's view of the same thing. On the popular side, Mental Science is free from the dogmatism of the Christian Scientist, and the superstition of the divine healer. The cases are the most fully reported, and the arguments of the advocates are most intelligible.

As previously stated Mental Science originated with Dr. Quimby, and we may now give a short sketch of his life and philosophy, to be followed by a brief account of the later developments of the movement and lastly by the data of the cures wrought by it.

Phineas Parkhurst Quimby was born in Lebanon, N. H., Feb. 16, 1802. While still a child his parents moved to Belfast, Maine, where he thereafter always lived, although he had an office in Portland the latter years of his life.

He had, perhaps, the average education of a boy in a small town, in those days. It was meagre as to actual book study, but evidently full of that suggestiveness which led him always to long for more. He had an inventive mind, being interested in mechanics, philosophy, and scientific subjects.

When about 36 years of age, a travelling hypnotist, elicited

his intense interest. "At that time, Mr. Quimby was of medium height, small of stature; quick-motoned and nervous, with piercing black eyes, black hair and whiskers; a well-shaped, well-balanced head; high, broad forehead, and a rather prominent nose, and a mouth indicating strength and firmness of will; persistent in what he undertook, and not easily defeated or discouraged." (New England Mag., Mar., 1888.)

He began at once to experiment, trying to hypnotize any one who would submit to the experiment. He soon found that he had some success and finally discovered a subject whom he could influence in a remarkable degree. With this subject he gave exhibitions for several years, travelling through Maine and New Brunswick.

He produced hypnosis, by sitting in front of his subject and looking him in the eye for a few moments. The performances were so remarkable that others began to investigate the matter, and Mr. Quimby was called upon to use the powers of his subject to diagnose disease. Mr. Quimby soon noticed that the diagnosis was always identical with what the patient himself, or some one else in the room, thought was the trouble.

This gave him his first suggestion of the connection between mesmerism and the cure of disease. From this time on he devoted himself to the study of what he considered the greatest boon to mankind, that had ever been discovered—the cause and cure of disease by mental states.

He soon found that the hypnotic state was unnecessary to the success of his work, and accordingly dropped that part of his practice, either because it was a bothersome and useless adjunct to his work of healing, or, as seems more likely, because in those days, mesmerism, especially when used in connection with the health of any one, was generally regarded as witchcraft, or some form of spiritism, and this brought his great discovery into undeserved disrepute.

Therefore, instead of going through the forms and ceremonies usually accompanying hypnotization, he simply sat by the side of his patient, talked with him about his disease, explained his own theory, convinced him that his disease was an error and "established the truth in its place, which, if done, was the cure." He sometimes, in cases of lameness and sprains, manipulated the limbs of the patient, and often rubbed the head of the patient with his hands, wetting them with water. He said it was so hard for the patient to believe that his mere talk with him produced the cure, that he did his rubbing simply that the patient would have more confidence in him; but he always insisted that he possessed no "power" nor healing properties different from any one else and that his manipulations

produced no beneficial effect upon the patient, although it was often the case that the patient himself thought they did.

Mr. Quimby's practice increased rapidly. In 1859, he made his headquarters at Portland though his home was still in Belfast. In Portland he became favorably known and treated many patients and performed some remarkable cures, as described in the papers at that period.

In 1866, Dr. Quimby was overcome by the pressure of work, which his unselfish devotion to humanity as he regarded it, forbade him to neglect, and he passed away at his home in Belfast, Me.

While he was undoubtedly hampered by some superstitions, for which the age was more responsible than he, and which his successors have in part perpetuated and increased, and in part outgrown; yet to him, undoubtedly, belongs the credit not of discovering that mind influences matter, nor yet of originating the philosopheme that all matter is the creation of mind, but rather of practically applying the principles to the prevention and cure of disease.

Whatever may be the future of mental healing, it must at least take its place as a valuable addition to our methods of coping with human infirmities.

A few quotations from Dr. Quimby's writings will show his point of view—his philosophy.

He says of his method: "I give no medicines; I simply sit by the patient's side and explain to him what he thinks is his disease, and my explanation is the cure. And, if I succeed in correcting his errors, I change the fluids of the system and establish the truth, or health. The truth is the cure."

"When I mesmerized my subject he would prescribe some little simple herb that would do no harm or good of itself. In some cases this would cure the patient. I also found that any medicine would cure certain cases, if he ordered it. This led me to investigate the matter and arrive at the stand I now take: that the cure is not in the medicine, but in the confidence of the doctor or medium."

"Now I deny disease as a truth, but admit it as a deception, started like all other stories without any foundation, and handed down from generation to generation till the people believe it, and it becomes a part of their lives. So they live a lie, and their senses are in it.

"To illustrate this, suppose I tell a person he has the diphtheria; and he is perfectly ignorant of what I mean. So I describe the feelings and tell the danger of the disease, and how fatal it is in many places. This makes the person nervous, and I finally convince him of the disease. I have now made one; and he attaches himself to it, and really understands it,

and he is in it body and soul. Now he goes to work to make it, and in a short time it makes its appearance.

"My way of curing convinces him that he has been deceived ; and if I succeed, the patient is cured. (1862)

"Man in his natural state was no more liable to disease than the beast, but as soon as he began to reason, he became diseased; his disease was in his reason."

Mental Science varies so much among the individual healers and leaders that it is impossible to characterize it under one head. One fairly representative statement is the following from an editor of one of the numerous journals devoted to this movement. He says that the movement is founded on the discovery that, "Mind is the only power; that this is God's world, and that all the people are his beloved children. The horrible, God-dishonoring dogma of hell and perdition crumbles and passes into nothingness before the marvellous light of Love. The angry, vengeful, jealous God who cursed the world for so many years—blighting hope, chilling love, scaring innocence and emasculating divine manhood—now veils his distorted features, and takes refuge in the dingy precincts of a few unenlightened orthodox churches. The God of Love, the All-good Father, now reigns supreme."

Such is their theology. Their healing practice grows out of that, and varies in its claims according to the nature of the healer—whether he looks to the theoretical side, the theological; or to the practical, the empirical. Some claim everything; others claim little more than the most enlightened and broad minded medical men admit.

The following quotations from a recent pamphlet (Christian Science and the New Metaphysical Movement, published by the Metaphysical Club, Boston,) emphasizes still further the differences between Eddyism, and Mental Science.

"Christian Science proclaims the unreality of matter and of the body. The rational and broader thought, not only admits the validity of the body, as veritable expression, but claims that it is as good in its own place and plane, as is the soul or spirit. While susceptible to mental moulding, it is neither an error nor an illusion. . . . It is to be ruled, beautified, and utilized in its own order, and not denied an existence. Even admitting that the whole cosmos is in the last analysis, but one Universal Mind and its manifestation even admitting that all matter is but a lower vibration of spirit, and that the human body is essentially a mental rather than a physical organism; still matter has its own relative reality and validity, and is not to be ignored as illusion."

The broader view "utilizes a practical idealism. It is entirely optimistic . . . understanding, both from ex-

perience and observation that a systematic employment of mental potency in a rational, scientific, and idealistic manner has a wonderful and unappreciated healing energy. . . . It does not antagonize common sense nor sound philosophy. While thoroughly loyal to principle, and the higher causation, and to an uncompromising spiritual philosophy, it recognizes that progress must be evolutionary. It does not ignore the good in existing systems, disparage reasonable hygiene, or deny the place of certain departments of surgery. It is not insensible to the present and provisional uses of simple external therapeutic agencies. . . ."

Mental Science is far more "scientific" than Christian Science in that it is free from the dogmatism, and seeks for a broad and general principle upon which to base its results. Being free from the domination of any one mind claiming infallibility, and without any organization, there is a much greater diversity in the theories and in the practices of the different healers. There is also a far greater readiness to accept the facts and to be governed by them, to consider the views of others, and to accept such as seem well founded. It must be remembered, however, that while this is true of the Mental Scientists as a whole, there are those who hold the extreme view that the "science" is fully established, is perfect in its theory and absolutely invariable in its results, and of universal application. At the other end are those who emphasize the empirical side. They have seen results, they know the method is sure under certain circumstances. They confess it is not in all cases, and whether it can be made so or not, they are in doubt. They use it for what good they can get out of it, and hope that time and experience will make clear the true limits or the limitlessness of the application.

These varying attitudes are extremely valuable to the student, and are worth presenting. They are well shown in the following extracts from personal letters received from prominent persons in this line.

Each letter is given entire and in the words of the writer, except that changes are made in names and dates, etc., in order to prevent recognition and so save the writer from any unpleasant notoriety.

CONDENSED PERSONAL OUTLINE—MENTAL SCIENCE.

M., 64. English descent. Sensitive, delicate organization; very conscientious; strongly intuitive; very imaginative; fairly intellectual. Subject to "ups and downs;" dominated considerably by conscious and unconscious fears and forebodings, which I now know were largely caused by early theological training. Academic education. In business inclined to overexertion. Intense business care and responsibility developed nervous weakness. Fears and forebodings prominent enough to cause mental disquietude. Alternations of de-

pression became pronounced. Fears began to take new forms. Every danger was magnified. Health broke and was obliged to quit business.

All this time was under best medical treatment, and observed hygienic rules. No permanent improvement, but managed to keep about the most of the time. Insomnia, dyspepsia, pain at base of brain, with a variety of kindred ills. Entire lack of nerve. Consulted famous physicians. No improvement. Acute attacks of tonsillitis, colds and fevers. Morbid impulses, hard to resist.

Persuaded to try mental healing. I had tried everything else, and was desperate, had but little faith. First healer made no impression. After month went to another. No change for two weeks, and then with sharp transitions for an occasional half hour or so, in a day, an interval of perfect mental and physical harmony. Great revelation. Had had nothing like it for years. New hope! But each time I dropped back, seemed as bad as ever. But slowly the harmonious seasons lengthened and became a little more frequent. Began to watch my own mental processes and sequences, and interested myself in the literature of the subject and the experiences of others. Gained gradual command. Old and new thought in conflict within, plainly felt and thoroughly diagnosed. Took some treatments off and on for two years, but growingly, the greater normality of self-healing dawned upon me. Increasingly learned to vanquish discordant and depressing thoughts. The beauty and immense importance of this principle of this practical idealism seemed to me a discovery—a truth beyond value. I intuitively became thoroughly idealistic and optimistic. I realized that the whole world is suffering, exactly as I had done, though in a less degree. Knowledge of the creative power of thought stood before me as the one great truth needed to cure the woes of the world. But the supernaturalism of the church and the materialism of science made and still make both hostile to such a philosophy. A feeling of at-one-ment with the Universal Goodness, may be systematically cultivated and may be depended upon to displace all opposites. I became convinced that these things are law, as exact as any law of physics or chemistry. Other experiences abundantly confirmed my own.

For six years past I have taken no medicine, and not been confined to my room for an hour. Temporarily, sometimes some of the old scars or slight remnants of old chronic conditions appear, but they give me no apprehension, and under the law are easily vanquished. I have more solid enjoyment now in one year, than in the thirty years from the time I was 20 until I was 50. The "Spirit of Truth" is a natural, lawful, and veritable teacher. The importance to the world of the harnessing of electrical forces, is infantile and puny, compared with the intelligent utilization of the power of thinking according to law.

F., 35.

DEAR SIR:

. my airy disposition and sanguine temperament finds mental analysis and descriptive retrospection very irksome.

Two years ago I was first interested on my own account in Mental Healing. In receiving both absent and present silent treatment (after I believed in the possibility of another's thought affecting me, if they willed it and I set up no barrier) I was conscious of thrills running up and down the body. The first treatments before I believed, made no conscious impression on the body, but I was restored to my normal buoyancy of spirit. The bodily ache did not begin to yield until five or six months afterward, when I began to try to help myself by saying and trying to feel that I loved everybody. I had for years

been deeply resentful toward one person and considered my final nervous breakdown three years ago (six months duration) much aggravated by the physician employed. As I gained control over my resentment through Auto-Suggestion and help from the healer I began to lose the physical ache. . . . Had no school training in psychology, nor church training which satisfied anything higher than my sense of the æsthetic.

Have left the Episcopal Church, as no creeds satisfy me. I worship God by cultivating the fruits of the Spirit and by daily aspiration towards "whatsoever things are true, honest, just, pure, lovely, and of good report." . . . The first intimation of the power of thought over the body was given me by a German physician whose prescriptions of iron and mineral water did no permanent good. One day after observing me closely, he said "guard your thoughts Fraulein." . . . It has taken eight years for that seed to fructify. I could never forget that sentence. After I broke down, in my 33rd year, and began to pull up, I was recommended to read some of the best works on this subject.

These settled my belief that one can become physically, mentally, morally, what they sincerely desire and will to. Intense desire and concentrated thought will draw out of the invisible into the visible . . . In music (I spent eight hard, weary years in Leipzig), in oratory, in psycho-physical culture, the highest, noblest, purest, has been drawn to me through the law of vibration. . . .

As for education, I was in and out of dozens of boarding schools, from life in British Guiana, Ireland, France, and New England, until twenty-one years of age; a foe to book knowledge, and a lover of running, dancing, swinging—anything that necessitated air.

This has been explained since reading zodiacal books—as I was born on the cusp between Gemini and Cancer, my earth sign being Sagittarius. Science, art, and spiritual development, are all that life holds for me. Facts, reason, judgment, do not attract me.

Sincerely yours,

F., 28. Nervous prostration, showing itself through physical exhaustion, lack of sleep, tears, and suppressed menstruation. Physically, had always been strong, but the other symptoms had always been noticeable from previous life since twelve years of age. Much nervousness on maternal side of family, with insanity showing itself in several members of second generation before me. Had taught for eight or nine years previous to illness, with great pleasure though it was largely a necessity. Temperament, great self-consciousness; great lack of trusting to the interior self for action; always planning what was to be done, no spontaneity or demonstration of the affections. Consequently, great contraction throughout the organism. Conscientious, thorough, and energetic. No interior consciousness as a fundamental support. Always went to a liberal Unitarian Church but had no home religious instruction and only for a short period at church. Religion was external, intellectual. My whole life wholly of the head, very little of the heart, almost none consciously of the soul. This last I consider the true cause of my illness.

Made no improvement under a prominent M. D. Grew distinctly worse at sanitarium, then returned home under care of an M. D. Grew very much better, but did not overcome symptoms, except tendency to tears.

At desire of an intimate friend went to Mrs. A. for mental treatment after nine months with the M. D.

Went to Mrs. A. in October. Improved; apparently recovered. In January following, felt less strong, returned to her, but apparently

received no help. Had no consciousness of incoming life, as had had at early treatments. Knowing no other resource went to my former M. D. again, and was then sicker than ever before, and more nearly on the verge of insanity. I believe if any one vibrates between medicine and mental healing, there is no permanent cure for them and they are likely to have an aggravated form of their former illness.

Next went to Miss B., Mental Healer, who had brought back to health a friend who had had a long illness like my own. The contrast between the result of this treatment and that from Mrs. A. lies in the fact that I went now from my own volition, feeling that this was my last chance; also I felt a greater affinity for Miss B. The treatments were more immediate and more marked in their interior effects. I did not make great physical gains, but my whole interior nature was shaken to its core. The physical effect was to make me sleepy, and to want to keep quiet and to want to read the Bible, which I had never cared for. The treatments were daily, half an hour long, with my hand in hers and in a relaxed position, so that I could rest or sleep afterwards. She gave no directions except to rest afterwards, and take more interest in what was going on about me, and break up old habits. Very soon I began to have a desire to lead a more religious life; then to see that all life was in mind, surging up into consciousness of my faults.

Since that time I have taken no medicine nor been under a doctor's care. Later, felt that Miss B.'s treatments were too stimulating, though really encouraging in power and value. To rest from such intensity of mental and spiritual action as it produced, I went South. Here I had treatment from Christian Science. Was always conscious of these absent treatments. It was as if a current of electricity was coming into and suffusing me. It was the same with Miss B.'s treatments except that Miss B.'s were more powerful.

Felt an inward charge to give up the treatments. By this time neuralgia had left me and I had resumed the habits of normal life. An imperfect digestion is all that remained of the old illness. For seven years have been able to care for myself by this thought method.

Was educated in public schools; fitted for Harvard. Taught.

All is God. All is good, in the fact that all is perpetual evolution under Divine law. We reap the fruits of our own sowing. Doctrine of reincarnation seems to me probable.

F. 47. American. I inherit a nervous temperament. I can never remember the time when I was well and free from pain; still I worked, teaching for several years, afterwards dressmaking, between long intervals of severe sickness. When 37, was told I had a tumor and its removal was necessary. Accordingly I was sent to hospital and ovariectomy was performed. Tubercles were also found and removed. My bowels were kept open two years and kept clean by means of inserted perforated tubes. Then they were allowed to heal. This was considered a very wonderful piece of surgery. But my courage was marvellous, for I was buoyed up by the hope of being perfectly well. But six years later another operation for fibroid tumor left me with no hope of recovery. Spinal neuralgia, intestinal indigestion, and worse than all, a brain incapable of any mental effort, all of which left me in a deplorable condition. Was refused admission to the hospitals because case too chronic. Two years ago was admitted to a mental healing home. While there, was constantly haunted by the fear that I should be dismissed as incurable. The treatments were mostly silent, and I seemed to be groping in the dark unable to grasp the truth. After four months treatment I was told that I had sufficient knowledge of the new philosophy to heal myself, and I came away with the feel-

ing that I was sent because incurable. Still there was a start in the right direction that was the beginning of a new life.

Then came a year of severe struggle alone. I had been reading a book on the subject, and tried to follow its directions as best I could. But my mind was so bewildered that it was incapable of reception. I received some help. Still doubts, fears, vacillation, impatience and worry had their effect, and the progress was slow.

Nearly a year ago, I received a copy of a Mental Science Journal. I wrote to the editor. She inspired me with hope. I believed she could help me and I began to take treatments. She taught me how to relax every nerve and muscle and to lean lovingly on her and to *expect* a realization of my desires. The treatments have been wholly absent, for I have never seen her, but their effect upon me has been marvellous.

A fixed time each day was given to the treatments, and the time strictly adhered to. The first requirement was relaxation, the second trust. In leaning upon her in this relaxed condition, I learned to lean upon the ALL WITHIN myself. The progress was slow (but there was a life time of weakness to overcome) but the improvement was noticeable from the very first treatment.

Two strong evidences of cure are: increased physical endurance and greater mental power. Yet while I am conscious of greater strength and clearer perception, I cannot conceive the time in any person's life when there would be nothing to overcome; and I find it just as necessary to hold myself receptive to the teachings of the Great Soul as at first. And of course I lean more and more upon *Its* guidance. Denials have little weight with me. My strength is in affirmations. While I think that health is after all, a secondary consideration, I know it *must* follow from right thinking and right living. Love fulfills the whole law of life. All things can be accomplished through this mighty force. Even death must yield to its power.

My reading on the subject has been limited, partly from choice, partly from necessity. Another's opinion cannot be mine. I listen to the Kingdom of the All Within me for the wisdom that never fails. This is the most essential thing I have learned in Mental Science, and this has the greatest influence upon my life.

There are millions and millions of forces awaiting our recognition and if we hold ourselves receptive to this Truth, there is no limit to our growth. I should say to all "Read less, think and practice more."

Sincerely,

DEAR SIR: Three years ago I was quite ill from nervous prostration, and a tendency to fall when I attempted to walk, and I also suffered from an abnormal action of the heart, and other effects of an exhausted nervous system. For a number of years I had been unable to sleep without quieting mixtures of some sort, and stronger ones were resorted to as the nervous system became weakened, and insomnia got the better of me.

As a result of these physical conditions, my mental condition was deplorable—or that is what I believed at that time. I had no hope, and was burdened day and night with the idea of continuing to be a burden to myself and to my friends. Naturally I am not despondent, but nervous exhaustion being considered hereditary in my family, and my physicians giving me little encouragement, I saw no way to regain health.

I thought because I was over 50 years of age, that I was less likely to recover than a younger person under similar conditions. I did not worry about business affairs, as I have no business occupation. I am an American with liberal views regarding religion, always having

believed in the fatherhood of God and the brotherhood of man; no church creed being so broad as my own inner perception of God and of duty, consequently I am connected with no church.

When health failed and faith in medicine was lost, I resorted as a forlorn hope to mental treatment. I was received as a patient by a mental healer. I remained there twelve weeks. The method was verbal suggestion and silent treatment. I can report no special feeling I experienced during treatment, only I hoped I would receive help.

And I did receive it. After a few weeks I was able to sleep well, and I took up life again with courage and purpose. I have continued to improve slowly but surely. The verbal instructions I received have enabled me to care for myself since leaving the home.

I think there was nothing in my school education that bore especially on the subject of spiritual science. I was educated in the common schools of my native town of ———, ———. I never studied psychology. I have read some philosophy, and much fiction.

I think that a study in this line, wisely selected and properly expounded, would, if introduced into the schools, be of inestimable value.

Very truly yours, ——— ———

F., 47. Neurasthenia, brought on by exclusive and highly unwise devotion to study outside of school hours, as a preparation for teaching; from worry; from the absence of all modes of expression except through teaching; withdrawal from the society of my friends; and from insufficient motor activity of any sort.

My trouble lasted about six months before I undertook mental treatment, which lasted three weeks. The only feeling I had was hope or desire that I might be relieved of the awful sense of burden that my school work laid upon me. I was not conscious that I was improving at the time. But I gained an increasing sense of the significance of certain passages of the Bible. I then went to the seashore, where I became conscious that I was really much better. The cure has been permanent. That is, I have not since had nervous trouble, and my general health is fairly good. An evidence of cure is that I do not live in fear that the disease may return.

I am not so convinced that mental healing is capable of curing any disease that I should have recourse to it in all cases. I have, since my recovery, had a physician in my family.

As to school, I am convinced that the soul of the child needs more recognition than it gets in the schoolroom; and that it must be nourished there as it is not now nourished. Nature lessons from the right point of view—revealing the inter-dependence of forms of life, and poetry wisely selected and taught by a truly sympathetic teacher, will do much to lift the child upon a higher spiritual plane.

(University education)

Sincerely, ——— ———

I was a constant sufferer for fourteen years and treated by a dozen physicians; ovarian tumor which was increasing in size, and with no hope except by a severe operation, and really no hope then, since the complications made it almost suicidal to put myself into the hands of the surgeon.

I had begun teaching at 16, and at 24 was a total wreck. I was under treatment by Mental Science eight months, then returned home cured. Undertook the care of the sick, immediately, and for eleven weeks did not get an unbroken night's rest.

Absent treatments were beneficial, but not as satisfactory as the "present." I knew the time that I was to receive them.

In some respects I noticed improvement in a few days, but had se-

vere struggles with intense pain and at one time was very low for a number of hours. Each time I went down came up stronger than before.

Have been well for eight years. My disposition is very much changed, and is very noticeable to my near relatives.

Educated in girls' boarding school, have read much history and good novels.

F. I was a natural student, educated in public schools of Maine, followed by two years at Mt. Holyoke Seminary, where in trying to crowd four years into three, and being in a state of anxious fear, slight deafness appeared, heat in head and throat and catarrhal condition, later, of whole mucous membrane. Many physicians, but only temporary relief. Two mental shocks from sudden death produced almost paralysis. Tried Mind Cure. Slowly I was led to believe that every state of mind effected the body expanding and contracting it, and to cure, the mental state had to be corrected. Improvement began at once; but it was more than a year before I was thoroughly convinced of the mental cause of disease and my own body well renovated, and still the deafness was not wholly overcome.

My cure came by being educated or growing into their way of thinking. Since then we have never used drugs in our family. There has been no return of old troubles. Some failures followed the efforts of these healers.

M., 77. Nervous. Congregationalist. American. Mercantile life. Disease hereditary. Eczema, began at age of 65. Treated by prominent physicians. Two months without medicine, then Mental Science. Absent treatment not satisfactory. Treated two months, then treated self.

Began to improve in two weeks, slowly but without relapses. Cure complete in three months. Cured two years three months. No return of eczema. Tumor all gone, also hernia and kidney trouble.

Belief in the science has changed my whole course of life, leading my mind to more spiritual thought, quieting my nervous temperament, more free from envy, hate, quick temper, and more free from anxiety. Think basic principles should be introduced into our schools at once. I never studied psychology, left school at 15.

Yours truly,

Temperament, nervous, sanguine; age about 45, American; occupation, piano-forte teaching; religion, liberal thought.

Hereditary headaches and weak digestion, then after the birth of one child, at 38, and subsequent hospital operation for laceration of the cervix, there was a gradual break down, until scarcely any organ of the body was in a normal condition.

Think now that most of it was fear and worry. Had at different times been under the care of 22 different doctors. Amongst them [names six prominent physicians of New York and Boston] and other local physicians. There was a morbid terror of cancers, and an inability to eat any food without fearing sick headache, which was frequently of 48 hours' duration and sometimes occurred three times a week. Treatment was given by [a mental healer] of Boston, by silent suggestion, and was immediately helpful. I had no faith in the treatment at the time, and was a disbeliever in the power of faith. For three years I have enjoyed the best of health and expect to so continue. The effects of the teachings absorbed have been most beneficial in changing my whole disposition. I no longer worry, can keep my temper, and am growing more patient. Therein, I firmly believe, lies the whole cure, and the "failures" of which I know many, are all

traceable to the wish to be healed without being willing to change the thoughts. I think I might write of fifty cases personally known to me, where recovery has been complete and lasting.

Nothing in my school education bore at all on this subject. Never read a work on psychology until three years ago. Was educated at a private school, since discontinued, in ———. Fitted for college at 16, but was debarred from entering at that time by the old ideas forbidding a woman to share education with her brothers. Have read almost everything appertaining to psychology during the last few years. Its effect is marvellous. It opens the gateway to health, happiness, serenity, advancement, both spiritual and temporal; develops the intellect, abolishes fear and worry, alters our old ideas of Divinity, and gives us more than a glimpse into a future state of existence.

F. 41. American. Unitarian.

Disease of spinal cord (lateral sclerosis). Given up by hospital authorities, as not likely ever to walk again. The disease accompanied nervous prostration, brought on by overwork in teaching.

Greatly depressed: mind dwelling on weak state and wholly ruled by bodily sensations. Learned Mental Science and improvement began at once. Attitude of mind entirely changed. From dwelling on weakness, and illness, my mind was turned toward health with full expectation of regaining it.

Found great help in the mental atmosphere of those about me, every one believing in my recovery. Left my healer after about four months. Since then—winter of 1894—my general health has been excellent, though I have not yet regained entire independence in walking. Use a cane. No result from absent treatment, though I tried to co-operate with the healer. There was a regular appointment as to time of these absent treatments. Modern languages and psychology studied.

The following personal letter is from a prominent scholar, who has taught in both English and American Universities and is a recognized authority in his department.

I can only say that when Miss ——— came to stay with us, my eyes were in a very bad state. They were inflamed and the lids granulated. I could hardly manage my daily work, to say nothing of MSS. and the like. I was wearing spectacles, as I had done for years, on account of a malformation in the left eye.

Under Miss ———'s treatment my eyes got well like magic; I gave up the glasses, and in a few days was all right; and for two years, if I remember rightly, I did not use the glasses again.

Possibly you might say that discarding the glasses operated beneficially. I can think of no other explanation that is not a psychic one. And I may say, for myself, I am satisfied with the psychic explanation.

I find my eyesight at present is growing weaker, especially the left eye, and I doubt whether I shall do much more difficult decipherment. Still there is not much amiss, and I think I still retain the evidence of Miss ———'s beneficial treatment.

Sincerely,

(The treatment in the above case was given ten or twelve years ago, this letter was dated Jan. 28, 1898.)

The foregoing letters are sufficient to give the reader a good idea of the theory and practice of Mental Healing.¹

We may take this opportunity to call attention to one fact, often misunderstood: It is supposed by many who have given no special attention to the subject, that those upon whom these methods are successful, are the ignorant or superstitious, or else those whose diseases are imaginary.

That such is not the case, is evident from these letters, and will constantly appear in others to be quoted later. Many of these people are college bred, nearly all show that they are cultured and refined.

As to their diseases, while we have thought best to omit names of physicians and institutions, we may say that in nearly all cases the names were given, and were physicians in good standing; and in some cases, the most noted specialists. So that while we may see later that the troubles were of mental origin, yet they were far removed from what is ordinarily understood by "imaginary."

Such cases as the foregoing are sufficiently striking to arouse interest in mental healing, and when we recall that they are only fair examples of cases that are being reported on all sides, we cannot wonder that the uncritical are continually being led to believe in the absolute infallibility of these methods.

Before jumping to this conclusion, however, it is necessary to examine critically all the circumstances that may explain these "miracles" by referring them to recognized laws. We have accordingly examined all the data for "internal evidence" of rational explanation on the basis of known facts; secondly we have searched medical literature for, first, physical conditions favoring the appearance or sudden disappearance of disease, and secondly for cases of "miraculous" cures in general medical practice. We have found much that tends to modify any hasty judgment that one might have been tempted to make.

The first thing to be mentioned is the hysterical diathesis. This is a condition far more prevalent and troublesome than most people realize. It is a mental state without, so far as is known, any pathological condition behind it. It is a form of mental alienation characterized, as Krafft-Ebing says, by great lability and emotional prodigality. It is perhaps best characterized as a condition in which the emotions preponderate over the intellect and the will. The disease exists in all degrees, from the slightest deviation from the normal to the completely insane. There are no pains that may not be of hysterical

¹Of the hundreds of similar letters, each one interesting and instructive, that we have received, lack of space forbids more than these few, in this article.

origin. Diseases of the joints are among the most common. Neuralgia is often of hysterical origin. The functional actions of the viscera are especially liable to derangement in hysteria. Any organ may be affected, but the stomach seems to be the favorite one. Not infrequently organic disease of the heart is simulated, there being palpitation and general irregular action of this organ.

Nor are the conditions thus manifested, superficial appearances merely. They frequently baffle the most skillful physicians, for a time at least.

It is impossible to tell what proportion of our cases belong to this class, but it seems very certain, from their own testimony, that a relatively large percentage belong here. One cannot read far in the records of cases without seeing it "between the lines" if not in them.

It is hardly necessary to add that mental science is just the thing for these people. Dr. Edes thinks it well (Shattuck Lecture, 1895, p. 48,) "to look the fact squarely in the face that some persons do receive great benefit from some of these forms of treatment who have failed to do so at the hands of regular and skilled practitioners."

Without doubt the different schools of mental practice have been largely recruited from this class of patients.

The question of diagnosis, although of great importance and having received much attention in our study, need only be mentioned here. Suffice it to say that we find a large percentage of cases diagnosed solely by the patient herself or her interested neighbors. (Comment is unnecessary.) Many others prove to have been the victims of "Quacks." Finally, the best physicians are fallible. And no one knows this so well as the physician himself. It is true he does not go around publishing his ignorance or the weakness of the science of medicine, he understands the influence of mind too well to do that, and yet he often finds himself helpless in the presence of symptoms that he cannot understand.

Mental healers often complain that the regulars will never acknowledge a cure by mental science, of consumption or any serious case, but always take refuge in wrong diagnosis. We ought not be surprised that the physician takes this view of the case. There are manifestly three possibilities—three explanations of any such event as the cure, *e. g.*, of cancer, by mental methods. Either the Mental Science view is correct, or cancer is not the incurable disease that it is regarded, or the physician was wrong in his diagnosis. Clearly men will differ as to which view they will accept. The physician, who knows the whole history, the physiology and etiology of cancer, who has seen every kind of remedy tried including divine healing, without

success; is the first to admit his mistake when he sees the disease that he thought was cancer, cured. He cannot do anything else, and he would do the same if his own remedies had cured the disease.

The mental scientist, however, again complains, and with apparent justice, that it is illogical and unscientific for the doctor of medicine to make an arbitrary classification and declare all diseases incurable which he has been unable to cure. And when a new claimant for therapeutic honors comes into the field, he rejects it on the basis of the old determination that such diseases are incurable. The argument is good, and yet, so long as the physician puts himself under the same rule, he cannot be accused of unfairness. In reality his procedure is the only possible one. Any other would lead to inextricable confusion.

We must act on the basis of what is most probable; and in this, Mental Science stands on the same ground as any drug. Whenever any remedy, be it drug or idea, is shown to cure cancer oftener than the law of chance will allow spontaneous cure or wrong diagnosis, then and not until then will it be accepted as a specific for that disease.

We have thus tried to show that the question of diagnosis must always be considered, and can never be settled. Cures based on the patient's own diagnosis, or that of a quack doctor, are of no value. Those based upon the diagnosis of a regular physician may have all values, from very small to very great. They cannot be valueless, since we all rely upon the judgment of these men, and if Mental Science will cure what the doctor of medicine has called a fatal malady, we will have Mental Science whether the doctor of medicine was right or wrong. Neither can Mental Science be established on the authority of any single physician, however great the presumption may be that his diagnosis was correct. Only the cumulative evidence of a great many cases can constitute a demonstration.

Spontaneous cures of all kinds of diseases are recognized by physicians. Spontaneous cure of consumption is not infrequent. The nature of cancer makes such an event possible, and it has been claimed, though most authorities say they have never seen such, and they rather doubt the evidence for it.

The sudden appearance and equally sudden disappearance of non-malignant tumors is a fact of such common occurrence as to excite no surprise in the minds of physicians.

J. William White, M. D., of Philadelphia, in an article entitled "The Supposed Curative Effects of Surgical Operations Per Se" (*Annals of Surgery*, Aug. and Sept., 1891,) has shown that many diseases have been cured by the "reaction of traumatism" due to the simple preliminary cutting; the intended

operation having been given up on account of the conditions found, rendering such operation impracticable.

Dr. White says of his cases "I have not intended to include in this article any extended cases in which the disease is purely imaginary, though the field that would be opened up in this direction would be very fruitful." (p. 173.)

(p. 174.) "In seeking for a reasonable explanation of the phenomena observed in the preceding cases, four influences are noted: 1. Anæsthesia. 2. Psychical influence. 3. Relief from tension. 4. Reflex action or the 'reaction of traumatism.'"

Upon experiment, anæsthesia was found to have either no effect, or else an injurious one.

On the question of psychical influence, he says "in so far as any case is of hysterical or imaginational origin, its cure by a powerful mental impression is easily understood. But only a small proportion of my cases were of this character, if the reporters may be believed."

"In so far as clinical experience goes it would appear that all kinds of tubercular peritonitis have undergone resolution after abdominal section and consequently that they are all curable."

William Goodell, Philadelphia, March 27, 1891, says:

I have had two cases of fibroid tumors of the womb as large as the adult head, dwindle down almost to an inappreciable size after an exploratory incision. In each case the object of the operation was the removal of the ovaries. But they lay behind a universally adherent tumor and could not be touched.

Joseph T. Johnson, Washington, D. C., March 24, 1891, says:

I have opened the abdomen in two cases when I did not know what was the matter, and don't now, but the patients both got completely well. One appeared to be malignant, and for that reason, upon the advice of all present, I abandoned the operation and told her husband I thought she would die. She got well and has since had a baby and is now in good health.

H. J. Boldt, New York, March 9, 1891, writes:

A young woman complained of most intense pain in left ovary. She really was in agony. This continued several weeks. She lost flesh, was bedridden, temperature 101 to 103, could not be touched in the ovarian or hypogastric region without a scream.

On opening the abdomen, absolutely nothing was found to account for the symptoms. She was merely washed out and sewed up again. Recovery in every respect was prompt and perfect.

Another class of cases that is often quoted as among the most startling, has to do with muscular functions. These are the inability to walk, from various causes, such as one leg short, paralysis, sprain, etc., etc. Dr. Dowie prays with these people, tells them to walk and they obey, much to the surprise of all, and to the glory of God as they devoutly believe.

But such phenomena are not unknown to the medical profession. Dr. Henry Ling Taylor has made a speciality of such cases, and achieved results as suprising as any reported by Divine Healing. He explains his method and gives illustrative cases in an article which he entitles, "Hygiene of Reflex Action." (Journal of Mental and Nervous Diseases, March, 1888.) The following parallel cases will show the general plan. Out of a great number of cases of cure by Divine Healing we must restrict ourselves to three.

M., 18. Diseased thigh bone nineteen months. Amputation ordered. Healed instantly. In three minutes was walking rapidly around the hall.

M., 40. Lame in one leg; paralysis, resulting from a fall of forty feet. A familiar sight in streets of Mansfield, Ohio, wheeling himself in his chair. After one week at D.'s he threw away his crutches. His limbs are not quite straight yet, but is confident they will become so. Two joints of spine were caved in; are now coming back into place.

This account was given in the paper in town where he was well known and was given as an accepted fact.

F., 19. Paralysis of right leg from knee down; no feeling in it; much withered; one and one-half inches short. Heel cord had been cut by surgeon and lacked an inch of meeting. Dr. Dowie performed the ceremony of "laying on of hands" and prayed. When he laid his hands on my leg, as he moved them down towards my foot, I could feel the blood trickling into the veins quite distinctly, and when he had reached the toes of my foot I had perfect sensation. He had gently pulled my leg during his prayer, and my leg at once lengthened to an equality with my left leg, in fact it was just a very little longer, and so it remains. Heel cord was instantly united. Five days later, walked ten miles without fatigue. Leg has grown to nearly the size of the other.

Compare these with the following mental cases treated by Dr. Taylor: (*op. cit.*, p. 138.)

M., 38. Suffered three months from sprained ankle, pain and disability; could not walk. Diagnosed as "disturbed reflexes." Began education of reflexes, and was discharged cured in six days; locomotion entirely normal. Eight months afterward, reported still perfectly well.

F., 50. Turned ankle two years previously, by stepping on orange peel. Pain, swelling, and disability. Had been worse during last six months. When induced to move ankle, said she had never tried before and did not know she could. Crutches were thrown away, and in a week she said she did not know she had an ankle. Entirely cured.

M., 17. Athlete. Left knee had given out while tramping in Germany, six months previously. Limped and thought knee was swelled. Had used a crutch and cane for ten weeks. Was energetic and ashamed of hobbling. The case was diagnosed as "limb suffering from disuse." Was made to stand up and bear weight on both feet. Inside of five minutes was walking around the table without assistance; went out on street and up front steps; at end of fifteen minutes he walked without a limp. His family were bewildered. Never had any trouble afterwards, and played on the Harvard foot-ball team Thanksgiving, 1887.

F., 12. Spinal trouble. Brought to office in a chair. It was perfectly evident that the entire family including patient were intently

watching for the development of expected symptoms. Diagnosis was made of "reflex debility, the effect of too much mother." On the ninth day she walked two miles, and the next day walked up stairs.

Young lady. Pott's disease; plaster jacket; great pain. In spite of remonstrances of parents, jacket was removed and exercise given. Went home in two months in fair health and much relieved. Later, relapsed.

F., 34. Bed and wheel chair for seventeen years. That this patient was walking within a *few days* and improved steadily in all respects, is due largely to her own intelligent and hearty co-operation, once the condition was explained to her.

These cases are so strikingly similar to a large class of the Dowie cases, that one cannot doubt that while the mental element is the chief feature in them both, yet Dr. Taylor would have been just as successful with Dowie's cases as he was with his own.

Attention is also called to the great liability to error in reporting cases. However good the intention, most people will forget some part of the facts. The way in which people understand or repeat what "the doctor said" is sometimes amusing and often provoking to the doctors.

POSITIVE TESTIMONY TO THE INFLUENCE OF MIND IN DISEASE.

In the preceding section we have attempted to give a fair statement of all the objections that can be raised to the evidence upon which the mental control of disease is supposed to rest. In the present section we shall sum up the arguments on the other side, and show the valid arguments in favor of this influence.

We may recall first, the great place that is actually conceded to mental influence in disease, by the popular mind. That sickness is often caused and cured by emotional states: as fear, grief, etc., is a matter of common experience. In every well regulated sick room, great care is taken to furnish the patient with pleasant and agreeable surroundings, because they help toward convalescence, and to shut out the opposite conditions, because they hinder.

Dr. Tukes's two volumes on "The Influence of Mind on Body," contains a valuable collection of these occurrences.

Perhaps the same argument will be urged by the unconvinced against the practice of mental therapeutics, that is used by telepathists, when one demands experimental proof, namely, that it is a force that works spontaneously, and cannot be harnessed into experimental methods. The very act of trying to observe it dissipates it, like the introspective study of an emotion.

As a matter of fact, however, we have abundant experi-

mental proof of the value of mental practice for the cure of disease.

In spite of the severe criticism that we have made of reports of cure, there still remains a vast amount of material, showing a powerful influence of the mind in disease. Many cases are of diseases that have been diagnosed and treated by the best physicians of the country or which prominent hospitals have tried their hand at curing, but without success. People of culture and education have been treated by this method with satisfactory results. Diseases of long standing have been ameliorated and even cured.

The numerous instances of temporary arrest of the disease, while not showing power to cure, yet exhibit a wonderful power of some sort.

Similarly, the cases where disease is cured in one part but breaks out in another part of the body, clearly prove the great power of mind, although they also show that the power is not unlimited. The most striking case of this, is the instance of the man who was healed of gangrene in the foot but died later of the same disease located in the eye.

We have traced the mental element through primitive medicine, and Folk medicine of to-day, patent medicine and witchcraft. We are convinced that it is impossible to account for the existence of these practices, if they did not cure disease, and that if they cured disease, it must have been the mental element that was effective. The same argument applies to these modern schools of mental therapeutics—Divine Healing and Christian Science. It is hardly conceivable that the large body of intelligent people who comprise the body known distinctively as Mental Scientists could continue to exist, if the whole thing were a delusion. It is not a thing of a day; it is not confined to a few; it is not local. It is true that many failures are recorded, but that only adds to the argument. There must be many and striking successes to counterbalance the failures, otherwise the failures would have ended the delusion.

The testimony of regular physicians to the efficacy and remarkable results of mental treatment is strong evidence of its value. The admission that they use it in some form is a further corroboration of the view that it is efficient. A few instances out of the many that have been collected, and the innumerable quantity that might be collected, are here appended.

One of the most prominent physicians of New York city prescribed salt water for a nervous affection that had defied all other treatment. His directions were: "Take 15 drops, and be careful not to take an overdose or it might prove fatal; and be sure to take it regularly." The patient rapidly recovered.

A certain druggist told the writer that he put up a prescription of salt water, for which he charged \$1, by the physician's direction, the physician explaining that unless the patient paid a high price, he would not think the prescription good for anything. He was cured.

An interesting illustration of the effect of the mind in causing disease, comes from a very prominent Chicago physician. He writes that on one occasion, he was very much interested in an important case that was referred to him, after failure by other physicians. He was intensely anxious to succeed. He discovered symptoms which had been overlooked by the others, of duodenal catarrh. He lay down on the couch in the evening, to read a recent work on the subject. He fell asleep from sheer exhaustion, his mind "full of the pathology, symptomatology, etiology and treatment of such conditions." He awoke in two hours with an *intense duodenal catarrh*, that lasted several days before he could get it under control.

FAILURES IN THE PRACTICE OF MENTAL THERAPEUTICS.

In the foregoing pages we have said little about failures in any of the different methods.

It becomes necessary, however, in our study of the question and our effort to reconcile the different practices, or find the law underlying them all, to consider the cases where they fail as well as those in which they succeed.

The ratio of successes to failure is impossible to determine, for part of the healers do not admit that they ever fail, and nearly all refuse to keep any record of failures. On the other hand, hypnotists restrict themselves at the start, and only use hypnotism in certain cases; of these they keep a careful record both of successes and failures.

That failures are numerous is the common belief, and is undoubtedly the fact. Indeed, unless *materia medica* is growing correspondingly impotent, they must equal the failures by the old methods, since there is no change in the death rate as a whole or the mortality from any particular diseases, in spite of the remarkable growth of mental practice in the past few years.

It has been exceedingly difficult to collect records of failure, for the purposes of study, since not only do the healers conceal their failures, but people who have tried to get cured by mental methods and failed, seem to regard it as a disgrace or at least a weakness, and will not report their experiences. Nevertheless by continued effort we have succeeded in finding several people who looked at the matter from a broader standpoint, and were quite willing to submit their own experiences or those of their patients (in the case of healers) for what they will show of value in elucidating the law of mental therapeutics.

Under the head of Divine Healing, occur many failures, and they are usually accounted for by the assertion that the patient did not have sufficient faith. Later we shall see in what sense this is true.

Dr. Dowie reports a few deaths in his "Home." Many of the patients say "not yet healed," though they are still hoping. Many of these finally give up in despair.

But the most conclusive indication of the extent of failure, comes from Dr. Dowie's own statement. He says, in a certain issue of his paper: "I pray and lay my hands on 70,000 people in a year." At that rate he would have prayed with 175,000 in $2\frac{1}{2}$ years. But in the $2\frac{1}{2}$ years immediately preceding this statement, he reports only 700 cures. The conclusion is indisputable that only a small portion of those prayed with are cured.

Failures by the Christian Science method are frequently brought to public notice by the courts, when parties are censured, fined or otherwise punished for neglecting to employ a regular physician, but trusting to Christian Science with results fatal to their friends. There are also many failures, that do not result fatally, and so do not get into the papers. The patient simply is not cured, and endures his disappointment and his ills with whatever fortitude he can command.

The following statement from a lady of culture, experience, and calm and unbiased judgment, is valuable and interesting for many reasons.¹ It will be noted that it comes from one who is neither a "healer" nor an opponent to the practice. She has all the interest which is involved in a mother's desire for the welfare of her daughter. Yet it is evident that she has not gone blindly into the matter, or closed her eyes to facts as they have come in evidence. The whole tone of fairness, and wise discrimination, is refreshing, and makes the testimony of extreme and unusual value.

It is as follows:

A partially successful case, was that of my daughter, whose temperament from childhood was extremely nervous. For several years she attended a denominational school, was very religious, and wished to enter into religious work.

At about the age of 22 she was very sick with a contagious disease. [The writer also mentions prominent physicians who treated her, at this time and also later.]

The disease left her with blood poisoning, resulting in nervous

¹The original letter was very complete and detailed, written with the utmost freedom and confidence but not for publication. The following condensation was made by the present writer and submitted to the lady for permission to publish, which permission was given. This accounts for its present form and the absence of some details.

prostration. She grew worse and a consultation was held. Dr. ——— pronounced her not insane, as we feared. She was sent to ——— [mentioning one of the most valuable medical institutions in the country], then went to a private institution. It was nearly a year before she came home, better, but far from well, still hysterical and hypochondriacal. She had taken no medicine (unless a simple calmative) for a long time, and discontinued that on coming home. Soon after her return, she heard of mind cure, and wished to try it. She improved somewhat under the treatment and afterwards continued it under ——— [mentioning one of the most experienced, most successful, and best Mental Science healers in practice.]

I think her treatment combined all the methods mentioned. The absent had the least effect. In those cases appointments were made for certain hours. Her mind was presumably occupied with peaceful and lofty thoughts, charity and good-will to all mankind. Bitterness, anger, resentment, even towards enemies, must not be entertained for a moment, otherwise the treatment would be ineffectual.

———'s treatment was continued regularly for about six months, afterwards given occasionally. The improvement was slow but generally steady. The next summer we thought the cure complete. The strongest evidence of the cure was the taking up again of her old duties and interests and submitting to suggestions and advice. The moral effects of the science were good, the tendency being to make one rise superior to all the annoyances and even the trials of life,—in short, it was a religion. Sometimes, however, this idea was carried too far.

I attribute the apparent success at first to the fact that she was taken out of the rut into which she had fallen. She had become a hypochondriac, and her physician had told her that she could help herself more than any one could help her. It seemed that where her malady was imaginary, the "Science" helped her, but where it was real, there was no effect. Her naturally vigorous constitution asserted itself for a time, but while the poison remains in her blood she can never be well.

For past nine years she has continued to a certain extent the same treatment, but it is without any perceptible effect, or at best only a negative one—she might be worse without it, and probably would, for her faith is undiminished, and she absolutely refuses to consult a physician for any ailment.

The literature that I have read upon this subject is quite beyond my comprehension, although I have tried earnestly to understand and believe in it. I recognize much that is beautiful and helpful in its teachings and believe they might be used to advantage in connection with medical science and remedies. I have known too many absurdities claimed for it and too many

fatalities resulting from trusting to it blindly, to have entire faith in it. Instance the case of ———. (Here is cited a tragic instance of death under this treatment.)

Neither in my school education or in that of my children, was anything taught bearing upon this subject nor upon any form of psychology.

I think it would be most unwise to teach such subjects to the young, at least until further knowledge brings them into the class of exact sciences. There is so much delusion, exaggeration and fraud connected with these subjects as to make it almost impossible for even mature minds to reach the simple truth, and there is too much of real importance and profit to be learned, to spend time uselessly.

In this statement I do not mean to include all psychology.

Sincerely yours,

There is abundant evidence that this letter might be considered practically a résumé of the entire mass of data so far as the points covered. The experiences here recorded, and the conclusions of the writer are strikingly typical.

But just now, we desire to point out a few of the noticeable points. To begin with, the daughter was "from early childhood extremely nervous and was very religious." These are the most favorable conditions for the successful use of Mental Science. This is admitted by all.

2. Her Mental Science healer was one who stands at the very top of the profession. 3. Absent treatment, for which so much is claimed, had "least effect." This absent treatment was by appointment, and at these times the patient put herself into the proper state of mind as far as possible. 4. It was thought for a time that the cure was complete, but it proved to be only temporary. The temporary cure shows that the patient received the teaching and profited by it. Nothing succeeds like success; yet, in spite of the success and all the moral strength that comes from it, there was a relapse, showing that there was a physical condition which mental methods, *under the most favorable conditions, could not reach*. It was not because the patient gave up, lost faith, and refused to accept the teaching. For nine years she has held firm to the faith, with no other result than that she has perhaps been kept from growing worse. Could any more complete test be desired?

The mother's statement that "where the malady was imaginary, the treatment was helpful, but where it was real, it had no effect," is easily in agreement with Wundt's declaration (Human and Animal Psychology, pp. 333-4) that "It cannot be denied that a cautious and intelligent use of suggestion [Mental Science] may be of avail for the temporary, perhaps

even for the permanent, removal of diseases due to the functional derangement of the nervous system. . . . But it is equally undeniable that suggestion is in the long run just as ineffective for the cure of diseases arising from some palpable pathological cause, as would be any other form of command to the patient to grow well."

By far the best data we have for forming an idea of the failures and their relation to the cures, is the following record of cases treated at a Mental Science Home. This institution is under broad-minded and philanthropic managers who believe that some people are cured by this method. The healer in charge is an intelligent man fully imbued with the principles of Mental Science, but also full of the true scientific spirit, so that he has regard to results as well as to his theory. All cases are welcome at the home, and all receive the best of attention and treatment. They stay until they are cured or discouraged or the healer is convinced that they cannot be further benefited. No pride or prejudice seems to be present to hide the facts. The following statements are clear and concise; accurate, as far as the healer is concerned. Doubtless many of them are the patient's own version of the case, while many are the diagnoses of prominent doctors of medicine previous to the patients coming to the "Home."

It will be seen that less than half are pronounced cured or well, less than half again only improved to a greater or less extent, while quite a large percentage (about 15%) were not helped.

The same disease is sometimes cured and sometimes not helped. These results agree remarkably with those of hypnotism, and altogether we believe are fairly representative of what would be found if we could get a careful record of all the cases treated by all the different mental methods.

Miss C. Spinal trouble, epilepsy, prolapsus of uterus, and malarial chills. Cured.

Miss R. Nervous prostration, neuralgia, epilepsy, and impoverished blood. Not much improved.

Miss B. Nervous dyspepsia, hemorrhoids, painful menstruation, sleeplessness. Improved.

Miss F. Pneumonia. Cured.

Miss S. Scrofula bunches. Cured.

Miss C. Sciatica, neuralgia, severe headaches and nervous prostration. Improved.

Miss A. Congested brain and spinal trouble. Improved.

Miss L. Cough resulting from pneumonia, nervous debility and depression. Improved.

Miss F. General debility, mental depression and eyesight impaired from inflammation resulting from a surgical operation. Cured.

Mrs. B. Stones in the bladder. Greatly benefited.

Mrs. M. Rheumatism, uterine trouble, indigestion and catarrh. Great improvement.

Miss W. Spinal trouble, and a growth in side. Cured.

Miss K. Uterine tumor and in too weakened a condition to admit of an operation. Four years could not speak aloud and two years could not even whisper. She was in an extremely nervous and weakened condition. A complete cure.

Miss B. Kidney trouble and nervous prostration. Cured.

Mrs. C. Hysterical, causing spasmodic contraction in the throat muscles, preventing her swallowing liquid foods with safety. Cured.

Mrs. T. Mental and physical troubles. Fully restored.

Miss F. Impaired eyesight, had worn glasses sixteen years and could not depend upon her eyes even with those. She left off glasses and her eyes were cured.

Miss K. Consumption. Improved for a few weeks then grew worse.

Miss C. Nervous prostration, dyspepsia, and painful menstruation. Cured.

Miss C. Eruption on face and chest, from chicken pox five years previously. Cured.

Miss W. Locomotor ataxia. Not benefited.

Mrs. W. Overwork, back strained by lifting, was unable to sit or stand without great suffering. Cured.

Mrs. L. Depression; little improvement. Constipation; relieved.

Mrs. B. Displacement and inflammation of uterus. Fully regained health.

Miss S. Advanced Bright's disease. Unsuccessful.

Miss H. Neurasthenia with hysterical symptoms; was never well. Change for better.

Miss T. Severe headaches from sunstroke. Very much improved.

Miss S. Nervousness and headaches. Unsatisfactory.

Mr. A. Mental trouble, unfitting for business five years. Greatly improved.

Mrs. D. Uterine trouble, hysteria and severe depression. Is well.

Mrs. D. Catarrh of bowels. Rigid diet five years; had spasms from changing diet and was unable to leave room. Eats any reasonable food and walks. Improved.

Miss F. Creeping paralysis. Stronger, but the trembling not improved.

Mrs. P. Paralysis of right side. Very little improvement.

Mrs. S. Nervous prostration. Marked improvement.

Miss S. An overworked teacher. Rested and strong.

Mrs. P. A humor, said to be incurable, uterine trouble and life-long nervousness. Cured.

Miss B. Mental trouble and lack of will power. Unsatisfactory.

Miss R. Paralysis or locomotor ataxia. Gained strength.

Miss S. Ovarian trouble, ulceration of stomach and bowels, liver in an atrophied condition. Cured.

Miss H. Uterine trouble, dyspepsia and general weakness. Cured.

Miss B. Dyspepsia and hysteria. Improved.

Mrs. F. Severe case of constipation. Uterine trouble and mild form of insanity. Cured of the first, much improved in second, and left us very happy.

Mrs. S. Uterine trouble, constipation, and nervous prostration. Very much improved.

Mrs. H. As severe a case of depression as we ever had, and nervous prostration. The cloud was lifted and she is bright and well. Cured.

Miss D. Nervous prostration. Improved.

Miss B. Uterine trouble and a nervous wreck. Much benefited.

Miss H. Uterine trouble, constipation, depression, painful menstruations, and nervous prostration,—an invalid from childhood. Greatly benefited.

Mrs. P. Cancer. Unsuccessful.

Mrs. R. Heart trouble and dyspepsia. Not much improved.

Miss C. Insanity. Not successful.

Mrs. S. Heart trouble, dyspepsia, and nerves in wretched condition.

Mrs. L. A tired and nervous teacher. Was ready for work when she left us.

Miss G. Painful menstruation. Greatly relieved.

Mr. H. Polypus tumor in nose, and very nervous. Greatly helped.

Mrs. C. Chronic hay fever. Permanently much improved.

Miss C. Heart trouble, rheumatism, and deafness. Unsatisfactory.

Mrs. G. Hysteria and insomnia. Improved.

B., 8 yrs. Malaria and a cough, result of whooping cough. Cured.

Miss C. Over study. Left well and strong.

Mrs. H. Heart trouble ten years. Some improvement.

Mrs. W. Ovarian trouble and addicted to morphine habit. Unsatisfactory.

Miss H. Spinal trouble, ovarian tumor with adhesions, inflammation throughout the abdominal region, enlarged and displaced uterus, rectal abscess, throat trouble, weak lungs, bi-

valvular affection of the heart, trouble with head and eyes, glasses for five years, abscesses for six years from belladonna poisoning, extreme sensitiveness of nerves and much numbness from same cause. My physicians said I had not a sound organ in my body. Glasses given up and eyes well. A complete cure.

Mrs. B. Heart trouble and nervous debility. Much improved.

Miss R. Difficulty in walking—doubtless locomotor ataxia. Unsatisfactory.

Mrs. H. Indigestion, uterine trouble, melancholia. Not ready for this treatment.

Rev. S. Stiff knee and spinal trouble from fall 13 years ago. Weak and lack of endurance. Gained in strength, but lameness not helped.

Miss S. Nervous prostration. Great gain.

Mrs. A. Extreme depression. Not satisfactory.

Miss R. Fibroid uterine tumor, and so depressed that she took very little interest in anything. *No change in the physical trouble*, but the great mental burden was lifted and she gained strength.

Miss M. Retroversion and inflammation of the uterus, and in such a serious condition that the physicians said she must undergo a surgical operation. This trouble of 20 years' standing, and dyspepsia of 3 years. Cured.

Mrs. B. Constipation, palpitation of heart, insomnia and general debility, greatly improved. Constipation cured.

Miss C. Consumption and general weakness. Gained strength.

Finally, we have in hypnotic treatment the most perfect demonstration of mental cures that can be found. Only one thing could be desired. The physicians who use hypnotism have been so careful, in their effort not to abuse it and not to endanger in any way their patients, that they have not tried it for all possible conditions, so that we do not know what it could accomplish under all circumstances.

But so far as it has been tried, we have exact data, and positive testimony to its power. Hypnotic suggestion is as certainly a cure for neuralgia as any drug that is known. The data furnished by hypnotic cures, is as free from the objections urged in the previous chapter, as one could reasonably demand. The use of hypnotism is confined, in its therapeutic aspect, to physicians of high standing, who assign to hypnosis a place equal in importance to drugs and other methods—and no greater. They test it as they would test a new compound or regimen. They study the results impartially. They have no theory to defend, no religious dogma to support, and their judgment is

not overcome by emotions due to the fact that they themselves have been healed by this method.

In view of these facts we may reasonably turn to hypnotism for the foundation of our more exact study of the theory of Mental Science.

HYPNOTISM AS A THERAPEUTIC AGENT.

In the therapeutics of hypnotism we come to a subject at once vast and valuable. Its vastness is indicated by the fact that in 1888, there were recognized 801 writings by 481 authors, and 207 periodicals containing articles on hypnotism. And in the past 10 years the interest and the literature has enormously increased.

We shall confine ourselves to a few careful practitioners, whose cases number something over a 1,000. Following are the facts deduced from these reports.

The range of diseases treated by hypnotism is not so large as we have found under Mental Science and Divine Healing, since physicians have not thought it right or advisable to try hypnotism in all diseases, while the theory of Mental Science and Divine Healing compels them to make use of their method in all cases.

Before going into the more detailed accounts of hypnotic cures, a word should be said about the manner of treatment, and some illustration of the methods given.

There are many methods of inducing the hypnosis, and there is some diversity in the kind of suggestion given after the hypnosis is induced.

The following cases are taken from the practices of four different men, and will indicate the scope of the work and the results.

Baierlacher reports using hypnotism on 58 patients: 24 males, 34 females, between 16 and 71 years of age. 7 M. and 8 F. were unhypnotizable.

He reports success in cases of colicky pains following abortion, catarrh of stomach, occipital neuralgia, irregular and painful menses (case of each), muscular rheumatism, and minor ailments. Reduced pulse from 92 to 76, and from 86 to 76. Consumptive pulse of 120 was not changed. Failures were met with in cases of traumatic neuralgia, traumatic neurosis, neuralgia of both legs, apoplexy, hemiplegia, persistent insomnia, emphysema of both lungs, and extreme dizziness.

According to Van Eeden, who reports 718 cases where he used hypnotism, only 19 of whom were unhypnotizable; nervous condition and sex have no effect in determining susceptibility to hypnosis; character and age, however, are important factors.

Dr. Van Rhensterghem states that of 178 patients, he failed to hypnotize 7. He treated 162, of whom 91 were cured, 46 improved, and 25 unimproved. There were 37 different diseases represented.

The following is a tabulation of a part of them.

	Treated.	Improved.	Cured.	Not Cured.
Rheumatic pains,	16	2	13	1
Various hysterical attacks,	24	7	14	3
Various neuralgias,	9	2	6	1
Epilepsy,	3	3		
Indigestion, etc.,	12	2	10	
Deafness,	11	7	1	3

Esdaile, who worked under the old belief in mesmerism or a "magnetic" fluid that passed from the hands of the operator to the patient, reports a few cases treated by him in India. He seems to have had unusual success in producing anæsthesia sufficient for the performance of difficult surgical operations. He was also successful in curing by hypnotic treatment several serious troubles.

The following is his statement:

(Mesmerism in India, by James Esdaile, M. D., London, 1846.)

A return showing the number of painless surgical operations performed at Hoogly, during eight months.

Arm amputated,	1	Sinus 6 inches long laid open,	1
Breast, ditto,	1	Heel flayed,	1
Tumor extracted from upper jaw,	1	End of thumb cut off,	1
Schirrus testium extirpated,	2	Teeth extracted,	3
Penis amputated,	2	Gum cut away,	1
Contracted knees straightened,	3	Prepuce cut off,	3
Ditto, arms,	3	Piles, ditto,	1
Operations for cataract,	3	Great toe nails cut out by root,	5
Large tumor in groin cut off,	1	Seton introduced from ankle to knee,	1
Operations for hydrocele,	7	Large tumor on knee removed,	1
Ditto, dropsy,	2	Scrotal tumors weighing from 8 lbs. to 80 lbs., removed,	17
Actual cautery applied to a sore,	1	Painless,	14
Muriatic acid, ditto,	2		
Unhealthy sores pared down,	7		
Abscesses opened,	5		
			Operations, 73

A return of medical cases cured by mesmerism during eight months.

Nervous headache, cured by one trance,	3	Lameness from rheumatism, by chronic treatment,	2
Ticdouloureux, cured by one trance,	1	Lumbago, by general and local mesmerising for a week,	1

Nervousness and lameness from rheumatism of 2½ years standing,	I	Sciatica, for general and local mesmerising for a week,	I
Spasmodic colic, by one trance,	I	Pain in crural nerve, by general and local mesmerising for a week,	I
Acute inflammation of the eyes, by repeated trances in twenty-four hours,	I	Palsy of one arm, by general and local mesmerising for one month,	I
Chronic inflammation of the eyes, by chronic treatment,	I	Palsy of half the body, by general and local mesmerising for six weeks,	I
Acute inflammation of testes, by repeated trances in thirty-six hours,	I	Feeling of insects crawling over body, by one trance,	I
Convulsions, by one trance,	I		
			18

"By chronic treatment is meant, daily mesmerising without the intention of entrancing the patient, which is not necessary."

(P. 22). Author recounts experience with most famous magician in Bengal. He shows that the magician's method of treatment is really hypnotism.

The following report of Dr. Parkyn¹ may be somewhat exceptional, but it is, nevertheless, very remarkable, and indicative of what may be expected from mental therapeutics.

He says :

"In the past eighteen months we have not seen a case of nervous prostration which has not been cured in a few weeks, when suggestion was properly used. Appended is a report of sixteen consecutive cases successfully treated at the Chicago School of Psychology within a short time, and without a failure.

Name.	Age.	Time disease existed.	Increase in wt. in pounds.	Length of treatment.	Result.
K. D. W.,	46	20 years	12 pounds	1 month	cured
L. M.,	23	8 "	14 "	1 "	"
C. T.,	30	2 "	9 "	3 weeks	"
F. B. T.,	51	3 "	12 "	6 "	"
W. M.,	47	5 "	6 "	1 month	"
Miss M. B.,	34	2 "	12 "	1 "	"
" M. C.,	23	3 "	8 "	1 "	"
" W. N.,	33	4 "	8 "	1 "	"
" H.,	30	1 year	14 "	2 months	"
Mrs. S.,	24	2 years	7 "	1 month	"
" G.,	43	3 "	10 "	2 months	"
" W.,	43	6 "	18 "	1 month	"
" J. C. N.,	57	2 "	7 "	1 "	"
D. R. G., ²	37	4 "	23 "	1 "	"
C. S.,	44	5 "	15 "	2 months	"
P. T. C.,	55	18 "	8 "	1 month	"

² Gained 12 lbs. first week of treatment.

¹ From "Suggestion an Infallible Cure for Nervous Prostration," by Herbert A. Parkyn, M. D. "Suggestions," Vol. I, No. 3, p. 105.

BERNHEIM'S HYPNOTIC CURES. (From Suggestive Therapeutics.)

A. Organic Diseases of the Nervous System. 10.

1. Cerebral hemorrhage, hemiplegia, hemianæsthesia with tremor and contracture. Cure.
2. Cerebro-spinal disease: apoplecticiform attacks, paralyses, ulnar neuritis. Cure.
3. Partial left hemiplegia. Cure.
4. Traumatic epilepsy with traumatic rheumatism. Cure.
5. Sensory organic hemianæsthesia. Cure.
6. Diffuse rheumatic myelitis. Improvement.
7. Cerebro-spinal insular sclerosis. Marked improvement for six months.
8. Nervous troubles (organic cause?) in the brachial plexus. Temporary suppression of the symptom. No cure.
9. Paresis of traumatic origin of the muscles of the hand. Cure.
10. Paresis of the extensors of the hand and saturnine anæsthesia. Cure.

B. Hysterical Diseases. 17.

11. Hystero-epilepsy in a man, sensitivo-sensorial hemianæsthesia. Cure.
12. Hysteria, sensitivo-sensorial anæsthesia. Transient suppression of the symptoms. No cure.
13. Hemiplegia with left sensitivo-sensorial hemianæsthesia. Cure.
14. Hysterical sensitivo-sensorial hemianæsthesia. Cure.
15. Hysteriform Paroxysms with hysterical somnambulism. Cure.
16. Anæsthesia. Hysterical spinal pain. Cure.
17. Paralysis with hysterical anæsthesia. Cure.
18. Convulsive hysteria with hemianæsthesia. Cure.
- 21, 23, 24. " " " " " "
- 20, 22. Convulsive hysteria. Cure.
19. Hysteria. Paroxysms of convulsive weeping. Cure.
25. Hysteria with hemianæsthesia. Cure.
26. Hysteria in male: weeping, convulsion, paroxysms. Cure—at least temporary.
27. Hysterical aphonia. Cure.

C. Neuropathic Affections. 18.

28. Nervous aphonia. Cure.
29. Moral inertia and subjective sensations in the head. Cure.

30. Nervous aphonia. Cure.
31. Post-epileptic tremor, cephalalgia and insomnia. Cure.
32. Nervous gastric troubles. Anæsthesia. Improvement.
33. Neuropathic pains. Cure.
34. Epigastric pains. Cure.
35. Neuropathic lumbar pains. Insomnia. Cure.
36. Paresis with sense of weight in right leg. Cure.
37. Pains in right leg. Cure.
38. Girdle pain and pain in right groin, with difficulty in walking for 20 months. Cure.
39. Insomnia. Loss of appetite, mental depression, tremor. Cure.
40. Gloomy ideas. Insomnia, loss of appetite. Cure.
41. Insomnia, through habit. Partial cure.
42. Cephalalgia, intellectual obnubilation. Cure.
43. Vertigo, moral depression connected with cardiac disease. Cure.
44. Laziness, disobedience, and loss of appetite in child. Cure.
45. Pseudo-paraplegia with tremor. Cure.

D. Various Neuroses. 15.

46. Choreic movements consecutive to chorea. Cure.
47. Choreic movements consecutive to chorea. Cure.
48. Choreic movements from moral emotion. Cure.
49. Post choreic tremor in hand. Cure.
50. Post choreic trouble in writing. Cure.
51. Choreic movements in hands. Cure.
52. Hemi-chorea. Rapid improvement. Gradual cure.
53. General chorea. Gradual cure.
54. General chorea. Gradual cure.
55. Obstinate writers' cramp. Rapid improvement. Gradual cure.
56. Attacks of tetany, nocturnal somnambulism. Cure.
57. Nocturnal somnambulism. Temporary cure.
58. Nocturnal incontinence of urine. Cure.
59. Nocturnal incontinence of urine. Cure.
60. Nocturnal aphonia consecutive to pneumonia. Cure.

E. Dynamic Pareses and Paryallyses. 3.

61. Sense of weight with paresis of left arm. Cure.
62. Dynamic Psychic paraplegia. Cure.
63. Pains and paresis of lower limbs. Cure.

F. Gastro-Intestinal Affections. 4.

64. Alcoholic gastritis with insomnia and weak legs. Improvement.

- 65. Chronic gastritis. Dilation of the stomach and vomiting. Improvement.
- 66. Gastric troubles. Burning sensation over sternum. Insomnia. Cure.
- 67. Gastro-intestinal catarrh. Metritis. Neuropathy. Improvement.

G. Various Painful Affections. 12.

- 68. Epigastric pain. Cure.
- 69. Umbilical and Epigastric pain. Cure.
- 70. Interscapular pain. Cure.
- 71. Thoracic pain. Insomnia. (Tubercular diathesis.) Cure.
- 72. Hypogastric and supra-inguinal pains on left, connected with old pelvic-peritonitis. Cure.
- 73. Intercostal pain. Cure.
- 74. Thoracic pain. Gradual cure.
- 75. Painful contusion of the deltoid. Cure.
- 76. Muscular pain in flank. Cure.
- 77. Painful spot in side. Cure.
- 78. Pains in the epitrochlea muscles. Cure.
- 79. Pain in shoulder and upper right limb from effort. Cure.

H. Rheumatic Affections. 19.

- 80. Rheumatic paralysis of right fore arm. Cure.
- 81. Rheumatic scapulo-humeral arthritis. Improvement without cure.
- 82. Muscular rheumatism, with cramp. Cure.
- 83. Ilio-lumbar rheumatism, neuralgia. Cure.
- 84. Arthralgia consecutive to an arthritis. Cure.
- 85. Pleurodynia and lumbar pain helped by suggestion. Cure.
- 86. Apyretic articular rheumatism. Gradual cure.
- 87. Chronic articular rheumatism. Cure.
- 88. Muscular, articular and nervous rheumatism. Gradual cure.
- 89. Acromio-clavicular and xiphoid rheumatic pains. Cure.
- 90. Muscular lumbo-crural rheumatism with sacro-sciatic neuralgia. Rapid improvement. Almost total cure.
- 91. Apyretic articular rheumatism. Gradual cure.
- 92. Acromio-clavicular rheumatic pains. Cure.
- 93. Muscular rheumatism arm and leg. Cure.
- 94. Gonorrheal rheumatism. Gradual cure.
- 95. Acromio-clavicular and xiphoid articular rheumatism. Cure.
- 96. Rheumatic articular pains. Cure.
- 97. Dorsal and meta carpal-phalangeal rheumatic pains. Cure.

98. Rheumatic dorso-lumbar, and sciatic pains. Cure.

I. Neuralgias. 5.

99. Rebellious Sciatica. Cure.
 100. Recent sciatica helped by one suggestion. Cure.
 101. Rebellious sciatica. Cure.
 102. Rebellious sciatica. Gradual cure.
 103. Neuralgia of trigeminus with facial ticdoloureux. Almost complete cure.

J. Menstrual Troubles. 2.

104. Menstrual retardation, suggestion of periods for fixed day. Success.
 105. Profuse menstruation every 11 or 15 days. Interval lengthened by suggestion to 28 or 29 days.

It is necessary to call attention with greatest emphasis to the utterly wrong idea of hypnotism present in the popular mind. The average man conceives of hypnotism as a diabolical power possessed by a few favored individuals, by means of which they can do anything they please with any other individual who is unfortunate enough to come within their influence. Thanks to scientific investigations, we now know that hypnotism in its complete form is only a condition of sleep, which has been produced not in the ordinary manner, but at the suggestion of some person, and with the understanding that the one so put to sleep is to do whatever he is told to do. The hypnotizer has no power that the subject does not give him. He cannot carry out his command to sleep, unless the subject is willing. Even after the subject is asleep, he need not obey the commands if he does not wish to do so. Of course, if the subject believes that the operator has power over him, he will always obey.

Hypnosis, then, is nothing more than artificially suggested sleep. "Suggestion"—the term for which we are indebted to Braid, is the fundamental principle upon which this "occult" power depends. A great deal of discussion has arisen as to the nature of hypnosis, much of which has tended to mystify, and make it more terrible to the uninitiated.

For example, much stress has been laid upon the method of inducing hypnosis, in efforts to get at the cause as well as the nature of it. All these discussions neglect the principle of *Suggestion*. The method employed has nothing to do with the cause of hypnotism. It may be the condition in that particular case, but cause it is never.

The cause of hypnotism is in the fundamental relation of body and mind; the method of producing it is by suggestion. The suggestion may be accompanied by any circumstance that

the operator may desire. The fixed gaze has no more to do with causing hypnotism, than a couch has with causing sleep. Were it not for the suggestion, either understood and believed beforehand, or explicitly stated by the operator, "After you look steadily at this object, for a short time, you will fall asleep," the steady gaze would not produce hypnosis any more than folding the hands would. The hunter fixes his gaze on the distant game, sometimes for hours, without falling asleep, or into the first stage of hypnosis. He has never been given that suggestion. If it were an accepted fact or superstition, that if he looked too long he would become hypnotized, then we should have no end of such experiences. In hundreds of trades it is a workman's business to watch an object or a machine steadily for long intervals. The biologist looks steadily through microscope from early morning till late at night. All the conditions are precisely like hypnosis, except the suggestion, which is wanting. Animals can be hypnotized. But animals gaze at their prey by the hour without hypnosis.

On the other hand hypnosis is produced under all kinds of circumstances, so widely different that the only possible element common to all, is the suggestion or expectation. Braid showed that patients would go into hypnotic condition, if only they thought they were being hypnotized, whereas, if they did not know that they were being operated upon, the most skillful hypnotists could not have any effect upon them. Bernheim states this clearly. (See preface to last edition.)

Again, much confusion has arisen from confounding hypnosis with the effects of suggestion when in the hypnotic state. Catalepsy, *e. g.*, is a condition of muscular rigidity that can often be produced by further suggestion after the subject has become hypnotized. But the question in regard to catalepsy, is not "what is its relation to, or how is it produced by, hypnosis?" but only "how does the body become rigid in response to a command to do so?" This is also the question that we would be glad to answer in regard to disease; though at present we are more concerned with the facts as to how far the bodily conditions *are* changed in accordance with the command or suggestion of change.

One has only to think of dreaming—a dream where the stream of thought is directed by some person—to understand the condition of things in hypnosis. The characteristic thing about dreaming is that one does not question the reasonableness of the ideas that come into mind. This is also characteristic of hypnosis, and upon this depends its value in therapeutics. Whereas, in the normal condition, any suggestion is met by other considerations, and may be rejected; in dreams or in hypnosis, no opposing ideas are met, and the suggested idea

takes possession of the mind. When once the idea has possessed the mind, there is a tendency for it to work itself out into a physical expression. This is the power of suggestion, and the essential element in hypnosis and in all mental therapeutics, as we shall show later.

The power of suggestion is best explained by reference to the nature of mind, and the relation of body and mind. Given an idea in the mind¹ and it of necessity does one of two things: It arouses another idea, or it "generates its actuality," *i. e.*, it translates itself into motor terms. In lower life, this is all that can be done. This we call impulsive action. If we might assume in the amoeba a consciousness, that stands to human consciousness somewhat as the amoeba body stands to human body, then we might say that when an idea of movement arises in the consciousness of the amoeba, its only possible effect or sequence is the translation of that idea into the actual motion. Not until we ascend to the top of the scale do we find that the aroused idea frees itself by arousing another idea. The very existence of animal life is dependent upon the sequence of idea by its motor equivalent. A sensation, a stimulus, gives rise to the idea—and this idea in turn discharges itself in motor form. Thus the needs of the animal are satisfied. Now the life of the species depends upon the perfection of this response, hence natural selection has developed this relation through all the life of the animal kingdom.

But the replacing of the motor consequent by another idea, could only happen after consciousness had so far developed as to hold one idea while another was being formed. A growth, so to speak, from one dimension to two. The amoeba consciousness being spoken of as a consciousness of one dimension, while the other is two.

In man the idea is commonly followed by another idea and that one by another, and so on until such time as the nervous tension becomes so strong as to discharge into the motor areas, then the motor response appears. But the sequence of ideas being a far later development, is correspondingly weak. The idea of movement is met by an idea of rest, or of movement in another direction, or what not; the result is, no movement is made. If, however, no second idea meets the first, then the motor response occurs and the movement takes place.

Now in all forms of voluntary suggestibility the subject, of his own accord, tries to make the sequence always *ideo-motor*, never *ideo-idea*. In so far as he succeeds in carrying this out,

¹This form of expression is used here and in other parts of this article, for brevity, merely, and does not imply an intellectualistic standpoint.

he becomes perfectly suggestible. In sleep opposing ideas are absent, hence hypnosis is the condition *par excellence* for suggestion.

APPLICATION OF THE FOREGOING THEORY TO MENTAL THERAPEUTICS.

We are now in a position to attempt a comprehensive explanation of all the forms of mental therapeutics.

It is an interesting fact that the adherents of any one form of "mind cure," say that all others are mere hypnotism. The Divine Healer thinks Christian Science is hypnotism; the Christian Scientist says Mental Science is hypnotism, and so through the whole list of rival schools. In the strict use of the word hypnotism, this is not true, since there is no "sleep condition" involved in any one of them. In every form with which we are acquainted, the patient is in full possession of his "wakened consciousness"—except in the avowed hypnotic treatment, and even here sleep is often very slight or even altogether wanting. Bernheim, Wetterstrand and others, often report "patient did not sleep" or "did not even close eyes;" and Dr. Parkyn declares that he prefers that his patients should not go into complete hypnosis—he thinks he gets better results without it.

In a scientific sense, however, it is true that *all* mental therapeutics is hypnotism, *i. e.*, it is suggestion. Suggestion is the bond of union between all the different methods, Divine Healing, Christian Science, Mental Science, etc. And the law of suggestion is the fundamental truth underlying all of them, and that upon which has built its own superstructure of ignorance, superstition, or fanaticism.

Man is a creature of suggestion. The differences in men consist in the differences in the suggestions that they have received and the ways in which they have reacted to them. The *ideo-motor* man—the man who instantly translates every idea into a motor consequent, is but little above the brute; he is a vegetative being, and his form of reaction will suffice for his vegetative needs, if he is not made the victim of a designing reasoner. Exceptions to this, are those acts which were formerly considered, but now having been uniformly approved have become reflex or automatic, and mark a higher rather than a lower stage. On the other hand, the *ideo-idea* man—the one who inhibits the motor response, and follows the idea by another idea in rapid succession until such time as it is wise to follow with the motor expression—he is highest in the scale. Between these two we have all degrees. A Christian Scientist said to the writer, that the largest part of his work and his hardest work was to counteract the influence of hypnotism.

He was only expressing a general truth in mystical terms,—suggested by his belief in mysticism. What he really meant was that his hardest work was to counteract the effects of evil suggestion, and this is the experience of all who are trying to realize higher ideals.

It is because people will act upon suggestion without thinking that evil has entered into the world. And here we must note that the motor side follows the idea, not only voluntarily and consciously as when I follow the idea of striking, with an actual blow, but also involuntarily and unconsciously, as when the thought of nausea produces the muscular movements characteristic of vomiting, or the idea of an accelerated pulse is followed by an increased heart-beat, or the idea of a diseased kidney is followed by actual derangement of the functions of that organ, or the idea of health is followed by the perfect functioning of all organs. More will be said of this unconscious reaction, in a later section.

Confining, now, our consideration of suggestion to its relation to disease, we may note a law and the almost infinite number of ways in which it is brought into action. First, in the causation of disease: the idea of disease produces disease, in direct proportion to its definiteness, and in inverse proportion to the strength of the ideas opposing it. By the first clause we mean that a clear and definite idea of a specific derangement of an organ, will produce such derangement quicker than an indefinite idea that there is somewhere in the body a diseased organ. *E. g.*, Mr. C. has a clear control of his heart action; he has a definite idea of his heart, where it is, what it is, how it works, how to influence its working. Mr. G. has no such control, he cannot accelerate or retard his heart beat, he has only a vague idea of his heart. Now Mr. C.'s idea that he has heart disease, will produce that disease, much quicker than G.'s idea. By the second part, we mean, that an idea must become fully accepted, and actually possess the mind, with no possible sign of opposition, for it to produce its full effect. Manifestly, these are both ideal conditions, and upon that fact depends our safety. Otherwise every idea of disease would produce actual disease in our bodies. They are equally ideal, when we come to the application of the law of suggestion to the cure of disease, and upon that fact is based the fallacy of most of the schools of mental therapeutics—those that claim that all diseases can be cured, and in all persons.

Let us turn to the facts with regard to the causation or disease. There are not a few people to whom the mere mention of a disease is a suggestion that they are suffering from it, and with the result that pain and often symptoms of the disease appear. It is a well known fact that medical students

frequently suffer from the diseases of which they study. The vivid descriptions accompanied by pictures of the diseased parts, are sufficient suggestion to them to produce the motor response. We have already cited a remarkable case, of the physician who produced a serious duodenal catarrh (page 464).

The individual differences in this particular, while unexplained, are yet wide and of great importance. Some people are so constituted that the sight of a sprained ankle causes severe pain and lameness in their own ankle which has received no mechanical injury. The sight of a bleeding wound may cause a red scar, more or less permanent, and correspondingly located on the person of one of these sensitive observers. At the other end of the scale, we have those people who are in no way affected by the most unusual sights. And between these extremes are all gradations.

Now, while we cannot explain this peculiar "sensitive-ness," this physical sympathy, it nevertheless is a fact and cannot be ignored. It is manifestly absurd to include all these people in one category, or to expect the same results from the same methods with all people.

If it is true that suggestion can cause disease, as well as account for many other remarkable phenomena, we have paved the way for the next step,—the proof that suggestion cures disease,—for as Dr. Hall says, "if mind causes disease, it is reasonable to suppose that it can cure the diseases that it causes."

At least it will be important to trace the rôle of suggestion through the different forms of therapeutics. We shall find that it takes forms varying with the philosophy of those affected by it. Among primitive people, the mere similarity of a plant, *e. g.*, to the part of the body affected, was enough to suggest that the plant would cure the disease. Witness the doctrine of "signatures." As man developed in intelligence and in civilization, he outgrew this form and required a stronger suggestion. But the appeal was ever to the mysterious—to some force or power that was just beyond his understanding—and as his knowledge advanced, he continually pushed that 'upon which he pinned his faith, farther back into the unknown. And to-day the same idea is true. So that whether the treatment be with the idea that the gods are appeased by the swallowing of nasty compounds, or that certain objects in themselves possess the healing power, or God answers the prayer, or obedience to some transcendental law of mind brings health, the principle is the same. The unknown is powerful; mystery makes the suggestion all potent. Schrader and Schlatter are mysterious men. They talk little, dress peculiarly, and claim miraculous powers. Their claim is undoubtedly much enforced by their appearance, which is strikingly sug-

gestive of the Man of Nazareth—at least as the mediæval artists were accustomed to represent him. All these are elements that help make the suggestion acceptable, so that when they profess to heal any one, that person is strongly impressed, and easily rises to a condition of new and greater hope and effort.

In Mental Science the appeal is to "laws of mind" by which mental states not only control physical conditions, but have created all that there is of the physical, both good and bad. As it has created, so it can destroy. Both this and Divine Healing have an element in common that is a powerful factor in the accomplishment of the result. This is the part of the teaching which abstracts the patient from himself and fixes his attention on matters external to himself. Later we shall discuss this point more at length.

Finally, in hypnotism, we have the same appeal to mystery, though it takes various forms according to the intelligence of the subject. The individual who thinks hypnotism due to an odyllic force, is taking his mysticism in its most cras form. While the man who understands suggestion, and voluntarily accepts the suggestions of the operator and is cured of his disease, is still appealing to that ultimate mystery of the relation of body and mind.

We have now seen wherein lies the strength of the suggestion as it comes from the different sources, and we can see why each form has its followers. The objections that arise in the mind of any sick person, are overcome, now by one argument, and now by another. It must be borne in mind in all these cases, that a powerful aid to the acceptance of the suggestion is the longing of the individual for health. It is an observation of Cæsar's, that men easily believe what they wish to believe.

Healers like Bradley Newell appeal to another mysterious force—namely magnetism. The same thing occurs in the various patent curatives known as magnetic belts, etc., which as we have seen, are entirely free from any real electricity or magnetism, and owe their power solely to the expectation that they arouse in the mind of the patient.

Patent medicines appeal to the mysterious power of certain powerful drugs supposed to be contained in them. The suggestion is made potent by constant and continual reiteration through advertising. The pictures and testimonials constituting a suggestion that it is impossible for a certain class of minds to resist.

The quack doctor has much the same explanation. If he advertises in newspapers less, he makes it up by his own personality and his claims of great power, which he parades with an air of honesty and humility which easily catches the inexperienced in such ways.

The so-called Divine Healing makes its suggestions acceptable by an appeal to the deepest that is in man,—the religious instinct. With Bible in hand it requires only a little skill to make it appear that the Almighty is waiting to heal every ill that man ever endured, if only man will fulfill the conditions. Various passages of scripture are easily made to appear to declare all this, and so, many a devout person finds in these suggestions the means of rising to a supreme effort with an entirely new hope. The suggestion is freely accepted and has apparently free course to "generate its actuality."

But, as we have seen, although the suggestion is fully accepted, yet there are physical conditions that this tendency toward health cannot overcome in the short lifetime of an individual.

The law of suggestion in the *cure* of disease, may be stated as follows: The idea of health tends to produce health in proportion to the strength of the idea, or inversely as the opposition to be met. This opposition to the acceptance of the idea of health comes from the presence of other ideas or beliefs, and also from physical conditions which require, often, long time for their complete correction. The time required weakens the strength of the fixed idea.

The latter is the most serious difficulty to be met, and constitutes the weak point in all theories and practices of mental therapeutics. It appears that the different healers have become so fascinated by the heretofore unknown powers of the mind, that they have ignored the physical side, as having anything to do with the matter, other than to be passive and allow itself to be regenerated as the mind shall determine.

There are two lines of thought in this part of the subject: First we have the difficulty which comes from the actual absence of the necessary organs or tissues, to carry out the suggestion. A man without eyes may by argument, or in a moment of religious excitement, be led mentally to accept the suggestion that he will see. But not having the necessary organs for that purpose, he is physically incapable of carrying out the suggestion. Some healers claim that "mind" can and does create organs as they are needed. Proofs of this are wanting, but we must admit their argument that, this being a matter so contrary to all tradition, the mind has an unusual amount of prejudice to overcome, and examples that can be demonstrated are in the nature of things hardly to be expected. We do not know what might be accomplished if the mind were free to accept the suggestion without opposition. Nevertheless it is perfectly clear that there is one element omitted which negatives all the claims of the healers. Time is this neglected element. It may be true that every idea has a tendency to

"generate its actuality," even to a lost leg. But it must take time for that idea to work itself out. One may believe that if man set himself to grow wings, and willed it persistently for generations and ages, he would achieve his purpose. But when we come down to the lifetime of an individual, and that, too, when it is half gone, life is too short. The time element cannot be neglected.

A second point strikes deeper yet. It is the reaction of the diseased organ, or the effect of the loss of an organ, upon the mind itself. We cannot deny the fact of such influence. All the methods of mental cure assume a mind in fairly normal state, and they acknowledge themselves helpless unless the mind of the patient is in a condition to react intelligently to their suggestions. But we know that there are many conditions in which a person cannot so act. We also know that disease has its own effect upon the mind. We do not know the laws governing this matter, and we do not know what conditions of body make it impossible for the mind to accept suggestions that would be easily received under other circumstances.

It is only reasonable to assume that there may be many such conditions. Hence, in accepting a form of mental therapeutics, we may be holding a true theory, but making a sad mistake by attempting to apply it under conditions that it does not fit.

We come now to the question of suggestibility from another standpoint. It also bears upon the matter just discussed and will help to make our conclusions clear. We have admitted that if patients could fully accept the suggestions of the healer, there might be more decided results. The thousand and one prejudices, questionings, etc., etc., keep the individual from giving himself up entirely to the idea that he thinks he accepts. We have, however, one class of data where the ideal condition seems reached in a measure. We refer to the hypnotic cures. Here the reasoning faculty being in abeyance, questionings or prejudices are much weakened or entirely excluded. In fact, it is the unanimous consensus, that the one characteristic of the hypnotic condition is that of accepting, with little or no question, whatever is suggested.

The following table compiled from 414 cases of Drs. Van Rhensterghem and Van Eeden, shows clearly that (1) the deeper the hypnosis the larger the percentage of cures. (2.) Even in the deepest hypnosis, not all cases were cured—even of those that were tried. (3.) Some classes of diseases are far less amenable than others.

The inferences from this table are extremely important, and help to answer several practical questions.

The first point referred to—that the deeper the degree of

hypnosis, the greater the therapeutic effect—may be elucidated by the following illustration :

RECORD OF 414 CASES OF HYPNOTIC TREATMENT.

A.—Diseases of the Nervous System.

B.—Other Diseases.

EFFECT OF TREATMENT.	Organic diseases.			Severe Neuroses.			Mental disease.			Neuropathic.			Functional Internal.			Functional External.			Total.					
	A.	B.	C.	A.	B.	C.	A.	B.	C.	A.	B.	C.	A.	B.	C.	A.	B.	C.						
	No.	%	No.	No.	%	No.	No.	%	No.	No.	%	No.	No.	%	No.	No.	%	No.						
No effect,	6	3	0	10	0	1	3	11	2	0	16	28	3	0	32	1	1	2	4	3	7	71	20	
Slight or temporary benefit,	6	1	8	6	7	0	13	10	3	0	13	35	12	3	50	2	3	1	6	2	2	92	26	
Permanent or decided amelioration	1	2	2	5	4	4	3	11	6	2	14	26	27	3	56	2	5	1	8	4	4	98	27	
Cure,	0	1	0	1	3	1	5	9	6	2	10	22	23	18	64	0	6	1	7	3	1	4	100	28
Unknown,	5	0	0	5	1	1	1	3	4	1	0	7	21	6	0	31	4	—	—	—	—	53	1	
Totals,	18	7	3	29	14	14	10	39	37	14	4	60	13	27	1	24	23	9	15	3	27	7	10	17

13 cases in which hypnosis could not be induced were divided as follows :—1, organic disease, no effect; 1, severe neurosis, no effect; 5, mental disease, 3 no effect, 2 unknown; 6, neuropathic, 1 no effect, 4 unknown, 1 cure.

Also 1 case fever, "A," no effect. 1 anaesthesia, "C," cured. 7 dysmenorrhoea, 1 "A," 3 "B," 2 "C," all cured. These are included in the respective totals.

A—Light Sleep.

B—Deep Sleep.

C—Somnambulism.

In the column headed "Neuropathic," it will be seen that of the 32 people upon whom the treatment had no effect, only

4 went into the deeper forms of hypnosis; of the 50 slightly benefited, 15 went into the deeper states ("B" or "C"); of 56 showing decided improvement, 30 went into the deeper hypnosis; and of the 64 cured, 41 went into deep sleep or somnambulism. The deeper the hypnosis the less the opposition to the suggestion of the operator; and the less the opposition, the more likely that the suggestion will produce the desired effect,—health.

This fact that the percentage of cures is greater in deeper hypnosis than in light, shows the difficulty in ordinary practice of overcoming the patient's objections or the unconscious counter-suggestions that constantly rise from the ideational centers.

A second point clears up a difficulty that we have already met in considering the claims of Christian Science. We have seen that while they admit failure to cure all diseases at present, they yet claim that the more perfect development of the individual in the new thought, the more complete acceptance of the suggestion, will accomplish the cure of all disease. But in hypnosis, we seem to have a state that is ideal, so far as the absence of distracting prejudices are concerned. The demand of the Christian Scientist for a test under conditions of complete acceptance of the teaching, seems here granted and with a negative outcome that all diseases are not cured. Not even are all cases of the same disease cured. Even those most skilled in pathology and in hypnotism cannot tell beforehand what case can be cured by the treatment. This seems to be conclusive proof that Suggestive Therapeutics must take its place by the side of drugs rather than to assume to supercede them.

The third inference corroborates this idea. Some classes of disease are, as a rule, cured by suggestive treatment; others are, as a rule, not affected.

It must be admitted at this point that hypnotism itself is not at its perfection yet. The operators are still more or less bound by tradition, and the belief that certain ailments cannot be cured. This belief they unconsciously communicate to their subjects. But in view of all the facts, it is altogether improbable that the results can be materially changed. The line of division between curable and incurable cases may be somewhat changed so as to put a few more on the curable side; but there is nothing to indicate that the claim of Christian Science can ever be realized. On the other hand, much in the nature of mind and of body, as well as what we know of their relations, points clearly to the other view.

PSYCHOLOGICAL PROBLEMS.

The facts of special interest to psychological science, which stand out from the preceding pages, and which require some further discussion, are three :

First. Pain *ceases* in accordance with these methods of treatment.

Second. Changes in tissues of the body are produced in accordance with the mental condition.

Third. The mental attitude of patients at all stages—before and after and during the cure—is one best described in terms of belief, or more explicitly, in terms of attention as modified and controlled by more or less conscious beliefs. Before the cure, the patient thinks about, and attends to, his pains and symptoms; in his cure, he ceases to attend to these, either neglecting them entirely, or attending wholly to the sensations of improvement that he is led to look for. After his cure, if it is permanent, his attention is directed outward, to normal human interests and the daily affairs of life.

Two questions arise in connection with these facts, viz.: What is pain that it thus appears and disappears with the fluctuation of the attention? and how does a mental state affect changes in body tissues? To propose to answer these questions would be the height of presumption, but we may be permitted to add a little to the speculation already extant. Although pain-pleasure has been extensively discussed, and many theories advanced, we seem to be still far from agreement on the main question of what pain is or its physiological basis. Whether there are special, pain nerves, end organs or brain centres, is a matter of dispute. Wedinski thinks all nerve fibres can feel pain; Fick says pain is mostly in the spinal cord; Wernicke declares that all basal centers with gray matter in them can ache. Edinger makes the internal capsule the pain center; Ludwig claims that he cut out certain parts of the spinal cord and destroyed pain in certain regions.

Marshal (Pain Pleasure and Æsthetics, N. Y., 1894, p. 204-5) says:

“ Whence we have the working hypothesis :

“(1) Pleasure is experienced whenever the physical activity coincident with the psychic state to which the pleasure is attached involves the use of surplus stored force—the resolution of surplus potential into active energy; or, in other words, whenever the energy involved in the reaction to a stimulus is greater in amount than the energy which the stimulus habitually calls forth.

“(2) Pain is experienced whenever the physical action which determines the content is so related to the supply of nutriment

to its organ that the energy involved in the reaction to the stimulus is less in amount than the energy which the stimulus habitually calls forth.

"In general we may also say that:

"Pleasure and pain are primitive qualities of psychic states which are determined by the relation between activity and capacity in the organs, the activities of which are concomitants of the psychoses involved."

Witmer, in what is probably the best paper that has appeared on the subject, of recent date, summarizes as follows: (See "Pain" by Lightner Witmer, in 20th Century Practice of Medicine, Vol. XI.)

1. Pain is a simple unanalyzable mental content.
2. It should therefore be called a sensation.
3. There is no conclusive anatomical evidence for the existence of a peripheral sense organ or nervous end organ for pain.
4. Nor for pain nerves or peripheral sensory neurons.
5. Much evidence justifies the conclusion that all or some peripheral nerves may under adequate stimulation, act with specific pain-producing function; that such nerves may lose their function without a loss of other functions or may lose other functions without losing the pain function. Thus pain may be a sensation of purely central nervous origin. The arousal of pain by stimuli and its presentation in consciousness along with other sensations, may be explained by the simultaneous association of pain with other forms of stimulation—an association that may take place at any level of the nervous system. (Analogous to colored sound.)
6. There is a specialized pain tract in the spinal cord which is certainly constituted in part of the gray column, and which may be composed of a part of the gray column of both sides, including the commissure and a part of the lateral tract. Into this pain tract nerves from the sympathetic system and from the internal organs, together with all specialized nerves from the periphery, discharge their stimulation when this is relatively intense. The intensity necessary to bring about this discharge may be that which is sufficient to overcome the resistance offered by the tract.
7. This tract passes up through the optic thalamus and posterior limb of the internal capsule, the "carrefour sensitif," into the cerebrum, and reaches some region unknown, but probably a part of the somæsthetic area. This hypothetical area may be looked upon as the pain center.
8. There is some warrant or justification for considering the pain tract in the spinal cord as the specialized nerve organ of pain, which together with the hypothetical specialized cortical center constitutes the specific organ of pain.

9. Any part of this central pain organ may be stimulated in the cortex or below it, either by stimuli discharging into it through normal physiological processes, by spinal or cortical association, by irritation due to disease, and perhaps by a vascular disturbance within the central nervous system.

Grant Allen (*Physiological Æsthetics*, N. Y., 1877,) says:

"Pain is the subjective concomitant of destructive action or insufficient nutrition in any sentient tissue. Pleasure is the subjective concomitant of the normal amount of function in any such tissue." (p. 29.)

But neither of these definitions recognizes the effect of attention on pain. This is perhaps due to the general idea that attention only effects the degree to which the pain is felt. It is of course a common experience that one feels their pain more when they give attention to it, whereas anything that can distract attention lessens the painful sensation. But this is only a part of the truth. The fact is clearly proved by the experiences of mental therapeutics, that the sensation of pain is absolutely removed by these methods which focus the attention on some extraneous object or idea. This accounts for the many supposed cures, which prove not to be permanent—pain is stopped, and since pain is the chief objective sign of disease, patient thinks he is entirely cured. If this is not the case, then we have to account for the actual change of the tissue from disease to healthy condition, in such a remarkably short time that the healers call it instantaneous.

Toward an explanation of these facts, may we not assume an hypothesis something like the following?

Every cell of the body has its own sensibility, and reacts to stimuli in a certain definite way if the stimulus is helpful and the opposite way if the stimulus is harmful. If we think of a primitive unicellular organism, we can easily imagine that in time, these two reactions would become distinguished, and consciously pleasurable and painful respectively, according as they were beneficial or injurious to the life of the organism. Then as we ascend to the multicellular organ and differentiation begins, one cell devoted to one kind of work and another to another kind, the liability to injury is increased, and the power of resistance is reduced, since the cell having developed greater efficiency in one direction has given up its power in another.

But here a new element comes in. The very fact of the associating together of different cells necessitates a kind of rough acquaintanceship. Each cell in the association must be stimulated by the cell adjoining it in a way that is neither the stimulus of a food particle nor yet an enemy. The recog-

nition of this difference in stimuli is the beginning of consciousness, or if Cope's view of archæstheticism, or primitive consciousness of the individual cell is correct, then we shall call this consciousness which recognizes adjacent cells as part of the same organism, the "general consciousness" in accordance with Stanley's terminology. The extent and importance of this general consciousness increases as we ascend the scale of life. When we reach the rudiments of a nervous system, this general consciousness takes a controlling interest in the corporation, and psychic life begins in earnest.

Henceforth we have a well regulated plan. We may liken the organism to a republic composed of individual states. The general government is concerned with the welfare and reputation of the body as a whole; each state—or cell—attends to its own affairs, does the work that has fallen to its lot, and settles its own difficulties as far as possible. When, however, the difficulty becomes too great, an appeal is made to the general government.

Now, in this multicellular organism, trouble is constantly arising; every cell is constantly receiving unpleasant stimuli and experiencing pain because of its own sensibility. Whether this cell-consciousness of pain will rise to the general consciousness, seems to depend upon two factors: first, the quality and quantity of the pain consciousness of the cell, and secondly, the amount of attention given to it by the general consciousness—to revert to our figure, whether the general government will become interested in a state trouble, depends upon the magnitude of the trouble and the amount of business the general government has on hand. Experience shows that we have all degrees, and every possible circumstance. We may give our attention to almost any organ of the body and in a short time we can find pain there. Normally it is highly probable that much that is pain for the individual cell or group of cells, passes without ever coming to full consciousness.

Finally, attention may be turned away from the cell group and strongly fixed on some extraneous object or idea, and then a pain of high intensity and involving a large area may fail to make itself felt. Instances are seen where a person suffers a severe injury, even a fatal wound, but under excitement feels no pain and is even ignorant of what has happened.

It seems reasonable that the second of the conditions enumerated should be the one most in accord with the highest welfare of the organism, especially if we are considering an intelligent being. Whenever an injury is of such a nature or extent as to endanger the life or efficiency of the organism, the attention of the entire being must be turned towards its

restoration. When, however, the intelligence has done all that can be done to remove the trouble, consciousness may and should be diverted in other directions, since, as Dr. Leach says: ("Albrutt's System of Medicine," p. 241,) "Pain and suffering, by their influence on nutritional processes, tend directly to prevent the return of tissues and organs to normal state;" or, as Dr. Edes puts it, "Attention constantly turned in on its own painful surroundings impedes healthy mental action as an ingrowing toe nail impedes healthy locomotion." (Edes—Shattuck Lecture 1895. p. 37.) Similarly, any injury of any less extent than this, need not, and in the best regulated organism must not, come to consciousness. And finally the absence of pain in the case of serious injury is a calamity which would in time destroy the species.

In mental therapeutics, the intelligence is appealed to, to do precisely what we have just seen is the wisest thing. In different ways the patient is induced to fix his attention on some idea other than his pain. He does this the easier from the conviction that he is in the care of those who are seeking his welfare. The Christian Scientist tells him he has no pain, and so distracts his attention by convincing him that there is nothing there to fix his attention on.

In hypnotism, again, the attention of the patient is fixed, perhaps, on the supposed power of the operator; finally, in Divine Healing, the patient fixes his attention on the Creator "who healeth all thy diseases."

The relation of the nervous system to this process is obvious. This higher consciousness is an immense advantage to the animal possessing it. But it is only possible where all the parts are so related that the cell consciousness of one part can be communicated to another part. In the lowest multicellular animals this is easily accomplished by simple contact. But as we go higher this was not sufficient, and those animals that had no better plan died. Those who could provide a line of easier conduction would survive. Thus may have arisen the nervous system which makes possible the interchange of cell-consciousness throughout the body. The place of transfer or for collecting all the sensations, is the central nervous system. And, as all kinds of combinations are possible here, so we have all possible degrees of consciousness resulting. Perhaps the simplest is the reflex arc of the spinal cord, which is commonly supposed to be unconscious. Then come the reflexes from the lower levels of the brain, giving rise to a greater or less degree of consciousness. The most complete combination of all the incoming sensations constitutes full consciousness. This has to do with the highest welfare of the individual. Health and the highest efficiency is obtained when this total

consciousness is made up of sensations, each of which has its full value, and no one of which occupies a larger place in consciousness than it deserves. Under such circumstances, any cell or group of cells comprising tissues or organs, whose derangement endangers the whole body, will be at once attended to, and the higher faculties of the mind brought to bear, to restore the diseased parts to normal condition; on the other hand any pain which arises from a purely local trouble will be neglected and allowed to take care of itself.

Such a theory as this assumes nothing inconsistent with known facts, and at least gives a possible explanation of the matter in question.

In concluding this part of the discussion we may quote from Stanley (Evolutionary Psychology of Feeling, p. 32-4.):

"The earliest living aggregations attain but a very slight degree of common life, and very slowly do the cells, under the pressure of serviceability in the struggle for existence, give up their independence and become interdependent, each thereby giving up some functioning to be done for it by others, and in turn functioning for others. Thus it is but slowly that a stomach is specialized, the cells in general in the organism long retaining and exercising some digestive function, which is properly termed sub-digestion. In this way a soup bath gives nourishment. If psychic function specializes gradually like other functions, we shall have in the same way a sub-form here, a sub-consciousness which stands for lower centers, and not for the whole organism as such. The wider, higher, and more specialized psychic center does not at once extinguish the lower.

"Now what is a *higher* organism but an involved series of combinations of combinations? With every new integration a higher plane is achieved, and the vital process has a wider functioning; but the psychical activity so far as it does not pass over into the service of the new and higher whole, remains as sub-function. With every new stage in evolution the integrating psychic factors only partially lose themselves in effecting a common psychism for the new whole, a sub-consciousness and a sub-sub-consciousness etc., are still carried on in survival. In man, physiologically speaking, it is the brain consciousness which is general. But we need not suppose this to extinguish all the lower ganglionic consciousness from which and by which it arose. If psychic function be correlative with other function, we must expect in man a vast amount of survival sub-mentality which, while not the mind of the man, is yet mind in the man. The individual knows necessarily only the general consciousness, for this only is his consciousness and constitutes his individuality, yet the doctrine of evolution would call for a vast deal of undiscoverable simple consciousness which never rises to the level of the whole organism's consciousness. A cell or a group of cells may be in pain and yet there be no pain in the individual's consciousness, and so unknown to this general consciousness.

"We have intimated that primitive consciousness may occur in a sub-conscious way in the highest organisms. But can this sub-consciousness ever be more than mere survival in its nature? or may it play essential part as basis of higher manifestations? If the integration of mentality is like other integration, *e. g.*,—material which is based on molecular and atomic activity—it will be bound up in the activity

of psychic units, which can be none other than sub-consciousness. That is, any common or general consciousness when looked at from below, and analytically is the dynamic organic whole of elements; it is a product of activities which are on another plane from itself. Roughly illustrated, I may say that my finger feels pain before I do. We conceive that at a certain intensity a sub-consciousness tends to rouse a general consciousness, and for a time maintain it; and losing intensity, the general consciousness disappears, leaving only the sub-consciousness, which may long outlast the general form.

"Sub-consciousness, whether as survival or basal, is put beyond our direct observation, but it remains a necessary biological and psychological hypothesis."

I have quoted somewhat at length, because of its bearing on the next section as well as on the preceding.

We may now proceed to discuss our second question: How can a physical change be effected, in correspondence to a mental change?

For convenience we may note that physical changes in the human body in its relation to health are wrought in four different ways.

First we have the voluntary changes. If eyes are painful, one closes the lids and shuts out the light. If an arm or a leg is the seat of pain, a change in its position may relieve it. We rest or we exercise a muscle or organ as we will, according to its condition or the condition we wish to produce. With the aid of the surgeon we remove diseased parts. All this is familiar, and while we really know nothing of how a movement is accomplished by the will to move, yet we are satisfied to leave that question and hide our ignorance under the sound of psychological terms.

Secondly, we apply drugs to the system, and by chemical or mechanical or molecular action produce changes in the condition of the system or some part of it. All this is every-day therapy.

Thirdly, we have shown in the preceding pages that outside of the voluntary muscles, and without any drugs, the physical condition is changed according to some law of mind, little understood, but roughly expressed in the formula, "believe you are well and health results." As we have already seen, a large part of this work is sufficiently explained, by the simple removal of worry or the distraction of the attention from the disease. We need not go into a discussion of the question: why too much attention to an organ is unfavorable to its functioning, and the dissipation of attention favors recovery. Indeed we cannot discuss it without a fuller exploiting of attention than is fitting here. It is sufficient to point out that such is the case—a fact which all will recognize—and to remark in passing that it seems most likely to be a relaxation of muscular as well as a mental attitude.

The result of attention to an organ is an unconscious muscular contraction which necessarily interferes, as a rule, with the normal functioning. The withdrawal of attention relaxes the muscles and allows normal action and nutrition.

The fourth class is made up of those cases of mental effect where the simple removal or relaxation of attention does not seem to account for the result. These are best seen in hypnotic cures, where, in accordance with the suggestion of the operator, a physical change is wrought unconsciously to the patient, such as the acceleration or retardation of the pulse; the raising or lowering of temperature, etc.

This class seems to demand the aid of some hypothesis of the unconscious or sub-conscious control of physical states by mental activity. Something akin to volition, but which is unconscious, would seem to be necessary to account for the facts. It is as though while we cannot get direct control of the heart, *e. g.*, and stop its beat or increase its rate, yet we can convey a message to some power within us, but of which we are unconscious, and this power accomplishes the desired result. This is the idea of Mr. Myers's Subliminal Consciousness Theory (P. S. P. R. Vol. VII, pp. 345-6), in which he argues for an unconscious *intelligence*, which directs the action of the involuntary muscles, just as a man directs his voluntary muscles.

This is not the place to discuss the different views of the unconscious; the reader can consult Hartmann, Cope, Clifford, Waldstein, Lewes, Stanley, and others who have written on it.

That consciousness holds only a small part of man's mental stock, is recognized by all psychologists; also that evolution gives good reason for all grades and degrees of consciousness. Perhaps Myers's statement sums this up as well as any. He says (*loc. cit.*) :

"We may regard the human organism as an aggregation of primitive unicellular organisms, which have divided their functions and complicated their union, in response to the demands of the environment and along such lines of evolution as were possible to the original germ. It is possible, too, that all these processes—beginning with the amoeboid movements of the primitive cells—were accompanied by a capacity for retaining the impress of previous excitations, a rudimentary memory which at first constituted all the consciousness which our lowly ancestors possessed. And further—may we not suggest—as evolution went on and more complex operations were developed while the primitive processes of cell change became stereotyped by long heredity, the memory which represented these earlier changes sank to a low psychical depth; became subliminal and

could no longer be summoned by a voluntary effort into the *super-liminal* sequence of conscious states. How do we know that any psychical acquisition is ever wholly lost? or even that a memory is the weaker because it has sunk out of voluntary control? It may be possible by appropriate artifices to recall primeval memories and to set in motion any physiological process which could at any moment of our ancestral history have been purposively, however blindly, performed."

This seems to be the line along which we must look for our explanation, and yet in the hypothesis of Myers there seems to be a flavor of mysticism which is not entirely satisfactory and not easy to comprehend.

May we not describe the whole process as follows?

It is a quite generally accepted theory now, that all reflexes were once conscious but have lost the conscious element through repetition and ease of performance; consciousness itself being dependent upon a sense of effort, when the thing is done without effort consciousness must necessarily vanish. This is on the physical side, and the motor phase. But when any given act was conscious, there was not only a definite movement of certain muscles, whose efforts to move gave rise to consciousness, but there was a definite nervous discharge in the cells of the nervous system. The volition which caused the movement had its concomitant physical element somewhere in the brain or spinal cord. This whole mechanism was set off by a conscious state of will, or an idea. Now, when the movement became automatic or reflex, what became of the brain path which had been worn by generations of conscious effort? Is it not possible that they too remain, not, indeed, as the well worn trails that they were when this particular movement was a conscious movement, but yet they remain distinctly different from the parts where no such paths have ever existed? They are like the old wood roads of a past generation, often noticed in the forest; no longer used, much overgrown, but still recognizable as the place of a former thoroughfare, and still the route that would be picked out if a new road were to be constructed for the same purpose. May it not be that the new volition which finds no conscious outlet for its energy, nevertheless finds an outlet along this old course, so slowly indeed that it gives us no consciousness of the fact, but nevertheless it reaches the same muscles and accomplishes the same result that the old volition used to do? Like the traveller who returns to his native city after long years of wandering, and finds nothing recognizable as he goes along the streets, cannot even tell the direction of his old home, and yet all unconsciously to himself he walks in the

right direction, makes the proper turns, and arrives at the very house he used to call home.

We do not know how to influence the action of the bowels directly, but the simple organism which was our remote ancestor, knew all about it, because his whole consciousness was occupied with that function, and whenever it was necessary to get rid of the waste products, he went about it just as we take a bath. And the traces of the old act are with us, since it is only necessary for us to fix our attention on the desired movement, and somehow, altogether without our knowledge, the desired result follows—the volition has found its way through the old, overgrown path.

Thus, it seems to us, we may picture to ourselves the way in which an idea generates its actuality without doing violence to any known facts, and without calling in the aid of any power more mysterious than primitive consciousness.

Dr. Edessays, in this connection (New England Invalid, p. 53,):

“It appears necessary that the influence which is to promote such a psychic change as must take place in cases of hysteria, and consequently in many of chronic invalidism, that which is to make the cerebral hemispheres again resume their control of the muscles, which is not merely to diminish the extreme sensitiveness to pain and fatigue, but inhibit that active search for it so commonly seen; that which is to set flowing again that nervous current which promotes nutrition; in a word, that influence which cures, whether in the hands of the physician who has studied the case and who knows it scientifically, or of the charlatan who makes no pretense to such knowledge or shrewdly guesses at it from the failures of his predecessors, must reach that psychical region that is not in full view of the ordinary consciousness, the so-called subliminal consciousness.

“It is apparently in some lower stratum of cerebral action that intellectual convictions are moulded into confidence, desire and activity, and there also apparently the same convictions may arise without the intervention of distinct perception or logical reasoning. There are those who hold that this region may be reached most quickly and certainly through hypnotism, *i. e.*, the patient is made more receptive and suggestible thereby. We have seen how it is reached by methods which have but little to do with the reason, and much with mystery and marvel. It is certain, however, that these are not the *only* channels through which an impression can be made, and it seems probable that when the physician, by beginning with the ordinary consciousness and by oft-repeated direction and encouragement, sometimes amounting to a re-education, can stimulate the motor powers of the will

and set them free from the inhibitory control of fear, habit, and hypochondriacal delusions, the result is quite as complete and permanent a one."

RÉSUMÉ AND CONCLUSIONS.

We have seen in the foregoing pages, that the psychical element is large in the cause of disease; that it played a prominent part in primitive and folk medicine; that it is the sole element in the so-called Divine Healing, after excluding all cases where some form of simple therapeutics might account for the cure; the same is true of Christian Science, Mental Science, hypnotism, and a certain amount of "regular" medical practice; the same element enters largely into patent medicine, patent devices, fads, and so through a long and ever increasing list. We have found all these alike in principle and all depending upon a fundamental relation of body and mind. This we have found best studied is hypnotism. From this study we have designated that "fundamental relation," by the familiar term "suggestion." And lastly we have attempted to review known facts with a hope of correlating our data more closely.

The conclusion from all this is that while the mind plays a large rôle in the cure of disease—greater than is realized—yet its greatest field is in the realm of prevention. Christian Science, Divine Healing, or Mental Science do not and never can in the very nature of things, cure all diseases; nevertheless the practical applications of the general principles of the broadest mental science, will tend to prevent disease.

Secondly we find nothing in the nature of mind or body, nothing essential in Mental Science, that is incompatible with drug therapeutics as such. We find no good reason why the two systems should not go on together. Indeed the solution of the present condition of rivalry seems to be a close alliance,—each helping the other.

While we find nothing to warrant the overthrow of the science of medicine, and no power that is able adequately to take the place of a thorough knowledge of anatomy and pathology or the skill of the surgeon, we do find sufficient evidence to convince us that the proper reform in mental attitude would relieve many a sufferer of ills that the ordinary physician cannot touch; would even delay the approach of death to many a victim beyond the power of absolute cure, and the faithful adherence to a truer philosophy of life, will keep many a man well and give the doctor time to study his science, and devote himself to the alleviating ills that are unpreventable.

Of Christian Science philosophy we find no justification in any of its *distinctive* features. The special features that

characterize it are in violent opposition to all that, in the light of history and present knowledge, the highest intelligences as well as the *vox populi*, regard as the truest philosophy and the best theology.

What Christian Science has in common with Mental Science, constitutes its sole claim to regard. Mental Science in turn, owes its value to its effort to make practical and bring within the reach of all, the best idealism of heathen philosophy and the Christian religion. So far it is worthy of all praise, help, and encouragement. But in this effort success has already attended it to such an extent that, lacking in scientific analysis, it has built up some erroneous theories which must eventually be sloughed off. Such is the whole theory and practice of absent treatments, in so far as it involves thought transference. Whether telepathy be true or not we do not pretend to say ; but we can say that we have found no evidence of it in any of the data that we have examined, and we thoroughly believe that every case where it is assumed, will be found to be either coincidence or the result of auto-suggestion.

There are also other notions which are too crude to last long, and which only characterize the infancy of the theory. But aside from these, Mental Science or the "New Thought," as some of its adherents now call it, seems to teach a sound philosophy and much practical sense in regard to therapeutics. It certainly can do the world no harm to have a body of people devoting themselves to emphasizing the mental side of life in these days of materialism. Indeed, so far as we are able to judge, the whole movement, as represented by the best of its promoters, is healthy and safe. And it is only when it is carried into absurdities that it becomes dangerous.

The fundamental principle of all mental therapeutics is the law of suggestion—the law that any idea possessing the mind tends to materialize itself in the body. Hypnotization is the idea of sleep, which has thus materialized itself, so that the subject sleeps. While in this hypnotic sleep the subject easily accepts further suggestion since his reason no longer opposes the suggested idea. The idea of health, which is then suggested, tends to be realized. This *tendency* which is admitted, is to be carefully distinguished from the *actual effect* claimed by the healers.

In Divine Healing, Christian Science, and other forms of mental healing, the reasoning which would oppose the suggestion is silenced, not by sleep, but by some powerful argument, dogma or assertion of the healer. If the patient accepts the teaching of the healer, without question, then the ideas which the healer suggests tend to work themselves out. And, as far as that healer is concerned, the patient is in a state

analogous to that of the hypnotic subject, though in all other respects he may be wide awake.

In both hypnotism and Christian Science it is the *fixed idea* in the mind of the *patient*—placed there by the healer or operator, or suggested by a book or elaborated by the patient's own reasoning—that accomplishes the result through its tendency to "generate its actuality."

In hypnotism we find no occultism, but rather a practice making use of perfectly natural laws and having its legitimate place in therapeutics. It is perfectly harmless, and the only possible danger from it comes from ignorance of its nature.

Finally, Divine Healing, as commonly understood, has no foundation for its theory. Not only are all its results readily accounted for by the laws of mind, but its results are not as great as those of the avowed mental healer.

The theory of Divine Healing is, if we mistake not, a positive perversion of religion. Nothing is more strongly shown by our study, than that the most striking and most successful cures are wrought by drawing the patient out from himself and his disease and fixing his attention on things higher and beyond himself. The thought that is fixed on another's interests is removed from one's own diseases, and the organs thus freed from attention have a chance to recover. Do not dwell on your ills, is the key note of it all. This is the truth which Mrs. Eddy has so travestied in her doctrine that sin and disease do not exist.

Now this altruism, which is thus seen to be the gist of all mental healing, is the very essence of Christianity. Religion has in it all there is in mental therapeutics, and has it in its best form. It teaches temperance in the broadest sense, high ideals and dependence upon the Highest alone. This preserves those who know it, by practice as well as by precept, from most of the ills that make up the list of those curable by mental methods. But further, it teaches a wise submission to the inevitable, a freedom from care and worry and the spirit of hopefulness. And these are the exact conditions aimed at by all mental practices. Living up to these ideas will do everything for us that can be done.

The state of mind has a powerful influence over the body, both for the cause and the cure of disease. Lofty thoughts, high ideals, and hopeful disposition, are able to cure many diseases, to assist recovery in all curable cases, and retard dissolution in all others.

Whatever the fundamental relation of mind and body may be, the aim of all conscious effort relative to physical well-being, should be to become unconscious of the organic life and its functioning.

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To persons outside of the University, an acknowledgment is also due, but they are too numerous to be mentioned by name. Physicians, clergymen, "Healers," and patients have been uniformly kind and courteous, and have freely contributed the data, without which the study would have been impossible. To them, one and all, I desire to express my thanks.

THE PSYCHOLOGY OF A PROTOZOAN.

By H. S. JENNINGS.

The nature of the psychic activities of unicellular organisms has of late become the object of considerable interest, though little work dealing with the problems in a fundamental way has been published since the researches of Verworn. The writer has recently made a perhaps more thorough study of the life activities of a typical infusorian, *Paramecium*, than has ever been made heretofore of any unicellular organism; the results of this study have been published in a number of papers in physiological journals.¹ This work was not done primarily from the psychological standpoint, and the papers referred to give nowhere a full and connected account of the bearings of these studies upon the psychological problems presented by the behaviour of the *Paramecia*. Yet taken together they enable an almost complete presentation to be given of the psychology of this animal; while there is reason to believe that *Paramecium* is in this matter typical of nearly or quite the whole class to which it belongs. In the present paper an attempt is made to bring together succinctly the observations which bear upon the psychic powers of this organism, in such a way as to present a complete outline of its psychology.

Paramecium is well known in every biological laboratory, living by thousands in pond water containing decaying vegetable matter. It is a somewhat cigar-shaped creature, about one-fifth of a millimeter in length, plainly visible to the naked eye as an elongated whitish speck. The entire surface of the animal is covered with cilia, by means of which it is in almost constant motion.

Now what are the phenomena in the life of *Paramecium* which require explanation from a psychological standpoint?

Examination shows that under normal conditions *Paramecia*

¹ Studies on Reactions to Stimuli in Unicellular Organisms. I. Reactions to Chemical, Osmotic, and Mechanical Stimuli in the Ciliate Infusoria. *Journal of Physiology*, May, 1897, Vol. XXI, pp. 258-322. II. The Mechanism of the Motor Reactions of *Paramecium*. *American Journal of Physiology*, May, 1899, Vol. II, pp. 311-341. III. Reactions to Localized Stimuli in *Spirostomum* and *Stentor*. *American Naturalist*, May, 1899, Vol. XXXIII, pp. 373-389. IV. Laws of Chemotaxis in *Paramecium*. *American Journal of Physiology*, May, 1899, Vol. II, pp. 355-379.

are usually engaged in feeding upon the masses of Bacteria which form a thick zoogloea on the surface of the water in which they are found. These Bacteria form almost or quite their entire food. A first question then might be: How do they choose their food, selecting Bacteria in preference to something else?

If Paramecia are placed on an ordinary slide such as is used for examining objects with the microscope, together with a small bit of bacterial zoogloea, and the whole covered with a cover-glass, it will soon be found that almost all the Paramecia, which were at first scattered throughout the preparation, have gathered closely about the mass of zoogloea and are feeding upon it. It will be seen even, that many Paramecia which cannot on account of the crowd get near enough to the mass to touch it are pushing close and shoving their more fortunate brethren, all apparently trying to get as near to the delicacy as possible. Some may be ten times their own length from the mass, but nevertheless crowd in from behind, apparently with the greatest eagerness. Here we have a related problem. How do the Paramecia collect thus from a distance about the mass? And what is the psychology of their crowding together thus, like a human crowd about a circus door? In the human crowd somewhat complex psychological qualities are involved; must we say the same for the Paramecia?

If we mount the Paramecia in the manner above described, but without the mass of bacterial zoogloea, we shall soon notice another phenomenon reminding us of human beings under like conditions. The Paramecia do not remain scattered as at first, but soon begin to collect into assemblages in one or more regions. It appears as if they did not enjoy being alone and had passed the word along to gather and hold a mass meeting in some part of the preparation; at least we soon find them nearly all in a little area near one end of the slide, with perhaps another smaller crowd off near the other end, while all the rest of the space is empty. Sometimes such a crowd becomes very dense; the Paramecia jam each other after the most approved human fashion, crowding as if all were trying to get near some popular orator in the center. If we watch such an assembly for some time, we find that the interest is apparently gradually lost; the Paramecia begin to separate a little,—not leaving the crowd entirely, but extending the area and wandering about its edges. The assembly thus becomes more and more scattered, the area in which the Paramecia swim back and forth being continually enlarged; but a rather sharp boundary is nevertheless maintained on all sides, as if by common consent no Paramecium was to pass farther out than all the rest.

Here we have what seems a decidedly complex psychological

problem,—the beginning, or perhaps even a high development, of social conditions. In the culture jars, also, we find the *Paramecia* gathered into swarms, and any proposed psychology of the Protozoa must account for these social phenomena.

Further, we find that *Paramecia* seem to have decided preferences in taste. They have a special predilection for sour, gathering with apparent eagerness into a drop of any solution having a weakly acid reaction, while their pet antipathy is toward anything alkaline in character. A drop of fluid having an alkaline reaction is therefore left severely alone and remains entirely empty when introduced into a slide of *Paramecia*. They also seem to show decided preferences as to heat and cold; they collect in regions having a certain temperature, leaving a colder or warmer area to gather in such an optimum region, just as human beings do. The whole question of how animals are attracted by certain influences and repelled by others is one of the most fundamental problems to be solved.

Thus the ordinary daily life of a *Paramecium* seems, on the face of it, to present many complex psychological problems. Apparently they feel heat and cold and govern themselves accordingly, have decided preferences as to the nature of the substances dissolved in the water, seeking some, fleeing from others; they live upon one definite sort of food and find ways of discovering a mass of such food even when scattered at a distance from it, and finally, they are social, being commonly found in swarms together and finding means of getting together even when scattered over a wide area.

From observations of this sort, some authors have concluded that such animals have a complex psychology, lacking few of the factors to be distinguished in the psychology of the higher animals. Thus, Binet says, in the preface to his book on *The Psychic Life of Micro-organisms* "We could if necessary, take every single one of the psychical faculties which M. Romanes reserves for animals more or less advanced in the zoölogical scale, and show that the *greater part* of these faculties belong equally to micro-organisms." Thus, it could be maintained from the brief summary I have given of the activities of *Paramecium* that these animals have *sensations* of various sorts, since they distinguish heat and cold, acids and alkalies; that they exercise *choice* in that they gather in the regions of certain agents, while they turn away from others; that such choice in itself implies *intelligence*; that the choosing and gathering about masses of food implies a *memory* of the qualities of this substance as compared with others; that they show such *emotions* as fear by fleeing from injurious substances (Binet expressly states this); that finally, acute senses, memory, choice, social instinct, intelligence, and a whole host of higher mental attributes, are

necessarily implied in the phenomenon of their seeking each other's society and gathering together even from a considerable distance into crowds.

Is it possible by a closer analysis of the phenomena to simplify this complex psychology which seems forced upon us by the observed facts?

First, we should examine a little more closely the structure of the animal to see what is here available for the production of these results. Often function depends upon structure to such an extent that what appears to be a complex activity is found to be only the automatic result of the simplest movements of a peculiarly constructed organ or set of organs.

Paramecium is an elongated animal, with one end (the anterior) narrower and blunter, while the other (the posterior) is broader and pointed. On one side of the animal (the oral side) a broad oblique depression, called the oral groove, runs from the anterior end to the mouth, in the middle of the body. Near the opposite side (the aboral side) are two contractile vacuoles imbedded in the protoplasm. The mouth is a small opening at the end of the oral groove in the middle of the body; from it a narrow ciliated tube, the gullet, passes into the internal protoplasm. In the center of the animal are imbedded the single large macro-nucleus and the single small micro-nucleus. The entire body is thus a single cell. Under ordinary conditions all the cilia of the body strike backward, which of course drives the animal forward. The stroke of the cilia is apparently somewhat oblique, for as the animal moves forward, it at the same time continually revolves on its long axis: in this way the oral and aboral sides continually interchange positions.

Now the structure and ordinary movements of the animal explain a certain activity which in higher forms may be associated with some degree of psychological complication, namely, the taking of food. Since the oral groove is ciliated like the rest of the body, when the cilia strike backward in the ordinary forward motion a current of water is produced running in the oral groove backward to the mouth. Small particles such as Bacteria, are thus carried automatically to the mouth. The mouth and gullet are ciliated and the cilia strike toward the interior of the animal, hence the particles arriving at the mouth are carried by the cilia into the interior, where they undergo digestion. The taking of food is thus purely automatic.

Moreover, as has long been known, Paramecia and similar animals seem not to exercise a choice as to the nature of the food which they take. Any small particles such as will pass readily down the gullet are swallowed with the same avidity as the Bacteria, it matters not how indigestible they may be.

But, as we have seen above, if a small piece of bacterial

zoogloea on which the animals feed is introduced into a preparation of *Paramecia*, the latter soon find it and crowd around it. It seems possible, therefore, that the choice of food takes place merely a step sooner than with higher animals, the *Paramecia* choosing the food by gathering around it,—then taking whatever comes. To test this we introduce a bit of filter paper into the preparation in place of the bacterial mass. The *Paramecia* collect about it exactly as about the zoogloea. They gather from all parts of the preparation and crowd upon it with the same apparent eagerness as previously upon the food mass. The same results are gained with bits of cloth, cotton, sponge, or any other loose or fibrous bodies. The *Paramecia* remain assembled about such bodies indefinitely, the oral cilia working away at bringing a current to the mouth, which current carries no food particles whatever.

Thus it appears that *Paramecia* exercise no choice as to the nature of the substances which they use for food, gathering indifferently about loose fibrous bodies of any sort, and swallowing particles of any kind or none at all, as chance may direct. We may cut out, therefore, any psychological qualities deduced alone from the supposed choice of food, putting in their place merely the fact that *Paramecia* react in a peculiar way when they come in contact with bodies of a certain physical texture. The reaction consists essentially of a quieting of the cilia over the greater part of the body, while those in the oral groove continue to strike backward, causing a current toward the mouth,—the body of the animal remaining nearly or quite at rest. It is important to recognize, in calling this a reaction, that it is not shown by a movement, but by a *cessation* of part of the usual motion.

Having been so successful in reducing the matter of feeding to simple factors, we may attack at once the most complex problem of all—the social phenomena shown in the gathering together of the scattered animals into a close group, as already described. Is there any way of dispensing with the sharpened senses, memory, social instinct, intelligence, and the like, which seem to be involved in these phenomena?

The possibility suggested itself that these collections might be due to the presence of some substance which was attractive to the *Paramecia*, and into which all would gather with one accord,—so that the fact that they approached each other would be a secondary result. This led to an extended study of the chemotaxis of *Paramecia*, the results of which are detailed in the first of the papers above referred to. It was found that *Paramecia* are attracted by all acids, and that in the case of any unknown substance having marked attractive properties, it can be predicted with a high degree of certainty that this

substance will be found to have an acid reaction. Carbonic acid (CO_2) especially was found to exercise a strong attraction on the infusoria.

Now these animals, like all others, of course excrete carbon dioxide, which must therefore find its way into the water. The quantity of CO_2 thus produced by one of the dense assemblages of *Paramecia* was shown to be distinctly appreciable by chemical reagents, by means of the following experiment: *Paramecia* were mounted in water to which a distinctly reddish color was given by mixing with it a small quantity of rosol. This substance has the property of being decolorized by carbon dioxide. The rosol does not injure the *Paramecia*, and they soon gather together in a dense collection, as in ordinary water. By observing the slide against a white background it is soon noticed that the solution is losing its color about the group of *Paramecia*. The colorless area after a time spreads, and at the same time the group of *Paramecia* begins to break up, as previously described. The *Paramecia* swim back and forth in the colorless area (that is, the area containing CO_2), from one side to the other, but without passing its boundaries. The colorless area increases in size, and the area in which the *Paramecia* swim back and forth keeps exact pace with it; the two coincide throughout.

The same phenomena may be produced by introducing a small bubble of CO_2 into the slide. The *Paramecia* collect closely about the CO_2 , pressing against the bubble. In this way a dense mass is soon formed. After a time, as the CO_2 diffuses, the mass loosens; the *Paramecia* swim back and forth in the area of diffusing CO_2 , not overpassing its boundaries. The phenomena caused by the presence of a bubble of CO_2 are identical in every respect with those which are apparently spontaneous. There is no question but that the assembling of the *Paramecia* into crowds is due to the presence in these crowds of CO_2 excreted by the animals themselves.

Thus it appears that our social phenomena, with all their implications of higher mental powers, have evaporated into a simple attraction toward carbon dioxide.

But how do the animals succeed in collecting from a distance? At first they are distributed throughout the entire preparation; when we introduce the bit of bacterial zoogloea or filter paper, how do the *Paramecia* discover its presence, so as to collect about it? From the general wreck of higher mental qualities, can we not save at least the *acute senses* necessary to account for these phenomena?

To determine how the *Paramecia* succeed in finding and collecting about a small solid placed in the middle of a large slide, it is necessary to study the ordinary method of locomotion of the

animals. "If a preparation of *Paramecia* on a slide, containing in one spot a small bit of filter paper is closely observed, the *Paramecia* are seen at first to swim hither and thither in every direction, apparently without directive tendency of any sort. . . . Soon a single individual strikes in its headlong course the bit of paper. It stops at once, often starts backward a slight distance, and whirls about on its short axis two or three times, then settles against the bit of paper and remains. Quickly another and another strike in the same way and remain. Now the excretion of CO_2 by the animals gathered together begins to take effect; the region becomes a strong center of attraction, and in ten to fifteen minutes, and often less, the paper is surrounded by a dense swarm of *Paramecia*, containing a large majority of all those in the preparation." (I, p. 299.) Thus, the finding of the bit of paper is due simply to the roving movements of the animals. Moreover, for gathering in an area containing CO_2 or other acid alone, a similar dependence upon chance motions appears. There is no swimming in straight radial lines to the area of CO_2 as a center; the *Paramecia* swim at random until they come by accident into the region of CO_2 ; there they remain. The precise place where a group of *Paramecia* is formed in some part of a slide into which nothing has been intentionally introduced that would act as a center of attraction is determined by chance factors. One or two individuals, perhaps, strike by accident a bit of solid matter suspended in the water, or a slight roughening of the cover glass; the thigmotactic reaction is set up, so that they stop, and as a result the region becomes a center for the production of carbon dioxide. The remainder of the collection is then due to CO_2 , and takes place in the manner last described.

We must, therefore, along with the rest, dispense with specially acute senses. The *Paramecia* do not react until they are in actual contact with the source of stimulus, and for coming in contact with the source they depend upon roving movements in all directions.

Thus we find that all more complex psychological powers deduced from the "social phenomena," as well as those from the choice of food, must fall to the ground. For explaining all the phenomena with which we have thus far dealt, but three factors are necessary: (1) the customary movements of the unstimulated animal; (2) the cessation of these movements, except those in the oral groove and gullet, when in contact with solids of a certain physical character; (3) attraction toward CO_2 .

We have still remaining to be accounted for psychologically the *attraction* toward certain reagents and conditions, as toward CO_2 and toward the optimum temperature, and the *repulsion* to-

ward other reagents and conditions, such as alkalies, and cold or great heat. This selective attraction and repulsion is a phenomenon of great importance, seeming in itself to imply a *choice* on the part of the organisms. If they move toward certain sources of stimuli and away from others, this seems to involve a perception of the localization of things, and this can hardly be regarded otherwise than as at least the beginnings of intelligence. Moreover, from its apparent general occurrence, much theoretical significance has been attached to it. Now *how* does this attraction and repulsion take place? Organisms usually move by means of certain organs of locomotion; attraction and repulsion cannot therefore be left as abstract ideas, but it must be shown how the attractive agent sets these organs in operation in such a manner as to bring the animal nearer; how the repellent agent succeeds in affecting the locomotor organs so as to carry the animal away. To apply this to the particular case in hand, when a drop of some attractive solution is introduced into a slide of *Paramecia*, how does it succeed in affecting the cilia of the animals in such a way that they turn toward and enter the drop?

Exact observation of the method by which the *Paramecia* enter such a drop shows that this question is based on a false assumption. *The animals do not turn toward the drop.* Such a drop diffuses slowly, so that its margin is evident, and the *Paramecia* may be seen in their random course to almost graze the edge of the drop without their motion being changed in the slightest degree; they keep on straight past the drop and swim to another part of the slide. But of course some of the *Paramecia* in their random swimming come directly against the edge of the drop. These do not react, but keep on undisturbed across it. But when they come to the opposite margin, where they would, if unchecked, pass out again into the surrounding medium, they react *negatively*—jerking back and turning again into the drop. Such an animal then swims across the drop in the new direction till it again comes to the margin, when it reacts negatively, as before. This continues, so that the animal appears to be caught in the drop as in a trap. Other *Paramecia* enter the drop in the same way and are imprisoned like the first, so that in time the drop swarms with the animals. As a result of their swift random movements when first brought upon the slide, almost every individual in the preparation will in a short time have come by chance against the edge of the drop, will have entered and remained, so that soon all the *Paramecia* in the preparation are in the drop. If, however, the drop is not introduced until the *Paramecia* have quieted down, it will be found to remain empty; this shows the essential part played by the roving movements in bringing the collection together.

Thus it appears that the animals are not attracted by the fluid in the drop; they enter it by chance, without reaction, then are repelled by the surrounding fluid. This is true for all apparently attractive reagents or conditions. *Paramecia are not directly attracted by any substance or agency*; the assembling in the region of certain conditions being due to the repellent power of the surrounding fluid, after the *Paramecia* have entered by chance the area of the conditions in question.

There remains then as a motor reaction only the *repulsion* due to certain agents and conditions. Is this repulsion an ultimate fact in the psychology of the animal, or is it possible to analyze it further?

The first thing which a *Paramecium* does on coming in contact with a drop of repellent solution is to reverse all its cilia, so as to swim straight backward,—at the same time revolving on its long axis in a direction opposite to that in which it was previously revolving. Next it turns to one side a certain amount, then swims forward again, on a path which lies at an angle to the path in which it was first swimming. Briefly stated, it adopts the very rational plan of backing off, turning to one side, and swimming on past the obstacle. We must apparently concede the *Paramecium* at least a modicum of intelligence for the very practical way in which it meets this emergency.

But suppose the animal touches the margin of the drop obliquely, or brushes it only on one side as it swims past it through the water; what course will it then take? From its sensible behavior under the previous conditions we shall expect it to sheer off, away from the drop, and keep on its way undisturbed or at a slight angle to the original path. But when we observe such a case, we find that the *Paramecium* backs off, swimming straight backward, as before, then turns through an angle, then swims forward, exactly as in the previous case. And curiously enough, it by no means turns directly away from the drop, but fully as often turns toward it, so as to strike it squarely the next time it moves forward. If this occurs, the whole operation is repeated; the animal tries, as it were, for a new opening. Sometimes it is necessary to repeat the operation several times before the *Paramecium* succeeds in getting away from the repellent object.

Under these circumstances the animal evidently gives much less indication of intelligence, and the fact that it reacts in exactly the same way under such different conditions is especially fitted to shake confidence in its mental powers. Apparently the swimming backward has no relation to the position of the source of stimulus, but occurs merely as a result of the fact of stimulation, without reference to its localization. Whether

this is true as a general statement can be tested by giving the animal a general shock without localizing the source of stimulus at all. This is easily done by immersing the *Paramecia* directly into solutions of such a nature that they act as stimuli. In such a case the stimulus acts upon the entire surface of the animal at once, so that there is no obstacle to be avoided and no reason for swimming backward.

Immersing *Paramecia* thus into solutions of different kinds, it is found that the first thing they do in every case is to reverse the cilia and swim backward. Nor is this all. The entire reaction is given, just as when the source of stimulus was at one end or one side; the animal first swims backward, then turns, then swims forward. This is true for all classes of stimuli,—chemical solutions of all sorts, water heated considerably above the optimum temperature, water at the freezing point, and solutions active only through their osmotic pressure. The duration of the different parts of the reaction varies much in different agents, but the essential features of the reaction are the same everywhere.

It therefore appears that not only the backward swimming, but also the turning to one side takes place without reference to the localization of the stimulus,—both occurring equally when the stimulus is not localized at all. But what determines the *direction* in which the *Paramecium* turns?

Careful observation of *Paramecia* under conditions which compel them to move slowly shows that after stimulation *they always turn toward the aboral side*,—that is, the side opposite the oral groove. The direction of turning is thus determined by the structure of the animal, and has no relation to the position of the source of stimulus. The mechanism of the turning is as follows: after the first reversal of cilia, those in the oral groove begin to strike backward again, tending to drive the animal forward, while the remainder of the cilia on the anterior half of the animal *strike transversely toward the oral side*. This results in turning the animal toward the aboral side.

We find, therefore, that the direction of motion throughout the entire reaction depends upon the structure of the animal and has no relation to the localization of the stimulus. The reaction may be expressed completely, omitting all reference to the position of the stimulus, as follows: after stimulation the animal swims with the more pointed end in front, turns toward the aboral side, then swims with the blunter end in front.

It is of course a matter of chance whether this turning toward the aboral side carries the animal away from the source of stimulus or toward it. Frequently the latter is true; in this case the operation is repeated when the animal comes again in contact with the stimulating agent. As the animal revolves

continually on its long axis, the aboral side will probably lie in a new position at the next turning, so that the animal will turn in a new direction. If this is repeated, the chances are that in time the obstacle will be avoided.

Thus, not only is it true that *Paramecium* is not attracted by any agent or condition, but also we cannot say, speaking strictly, that it is repelled by any agent or condition. Certain agents set up a reaction in the animal, the directive features of which depend entirely upon the structure of the organism,—just as certain stimuli cause an isolated muscle to react. We cannot say that the *Paramecium* is repelled by the stimulus, any more than we can say that the contraction of the muscle is due to the muscle's being repelled by the stimulus. It is true that the source of stimulus is more often at the blunt or "anterior" end, in the case of *Paramecium*, so that swimming toward the sharp end does, as a matter of fact, usually result in taking the *Paramecium* away for a short distance from the source of stimulus. But this usual position of the source of stimulus is from a physiological standpoint purely accidental, and the reaction produced is the same whether it occupies this position or another. If the animal is stimulated at the posterior end, it swims backward, therefore toward the source of stimulus; in this way it may enter a destructive chemical solution and be immediately killed, though the same chemical acting upon the anterior end would of course have caused the animal to swim away. This is seen in a particularly striking manner in the larger infusorian *Spirostomum ambiguum*, which is so large that it is easy to apply a stimulus to any desired part of the body. It is then found that the animal reacts in exactly the same manner whether stimulated at the anterior end, the posterior end, or the side, the direction of motion having absolutely no relation to the position of the source of stimulus. The same is true for *Paramecium*, though its smaller size makes the demonstration more difficult.

A strict parity is therefore to be observed between the reactions of *Paramecium* and those of an isolated frog's muscle. *Paramecium* responds to any stimulus by a definite, well characterized reaction. "The same may be said of the isolated muscle of a frog. The intensity of the reaction varies with the nature and intensity of the stimulus; this also is true for the muscle. Under certain influences the *Paramecium* remains quiet; likewise the muscle. The directive relations of the motions are determined both in the *Paramecium* and in the muscle by the structure of the organism, not by the position of the source of stimulus. There seems, then, no necessity for assuming more in order to explain the reactions of the *Paramecium* than to explain the reactions of the muscle. We need, there-

fore, to assume nothing more than irritability, or the power of responding to a stimulus by a definite movement, to explain the activities of *Paramecium*" (II). The long catalogue of psychical qualities required to account for the movements of *Paramecium* is thus reduced to simple protoplasmic irritability.

The method by which *Paramecia* collect in the regions of influences of a certain character and leave other regions empty, may be stated in general terms as follows: Certain stimuli cause in the animals random motions, in which the direction is frequently changed, especially at the moment when the stimulus begins to act. These random movements result, through the laws of chance, if continued long enough, in carrying the *Paramecia* out of the region of influence of the agent causing the stimulus. Coming thus by chance into a region where such movements are not caused, the *Paramecia* remain; if this ineffective area is small, the *Paramecia* are crowded together within it and give the impression of being strongly attracted by it.

"It is evident that we have in this case as near the reaction postulated by Spencer and Bain for a primitive organism—namely, random movements in response to any stimulus—as is likely to be found in any organism. The motions are strictly random in character so far as the position of the source of stimulus is concerned. . . . And by the repetition of the reaction the direction of movement is frequently changed,—always without reference to the localization of the stimulus. It appears not to have been foreseen theoretically that such random movements would of themselves, if continued, carry the animal out of the sphere of influence of the agent causing them and keep it from re-entering. To accomplish this result it is only necessary that the direction of motion should be changed at the moment when the stimulus begins to act and at intervals so long as it continues" (II).

An examination of the activities of a number of other unicellular organisms in the light of the observations above detailed shows that they react in essentially the same manner. For each organism a simple statement can be given for the reaction to any stimulus. For *Spirostomum ambiguum* the reaction is as follows: the animal contracts, swims backward, turns toward the aboral side, and swims forward. *Stentor polymorphus* contracts, swims backward, turns toward the *right* side, and swims forward. A number of flagellates also have been found to have such a fixed method of reaction. In all these cases the direction of motion has no relation to the position of the source of stimulus, and the conclusions to be drawn for *Paramecium* apply equally to these organisms.

In regard to the position in the psychological scale to be as-

signed to *Paramecium* the following may be said: The reactions of *Paramecium* are, as we have seen, comparable in all essentials to those of an isolated muscle. In neither case has the direction of motion any relation to the position of the source of stimulus. Reaction in such a manner as to show a relation to the position of the stimulating agent has rightly been regarded as a first and lowest step in perception; this lowest step is quite lacking in *Paramecium*. Moreover, *Paramecium* has no "life history" in the sense of a change in its reactions such as between the reactions of a young and an adult higher animal. An individual undergoing division reacts exactly like the ordinary *Paramecium*, as do likewise the halves immediately after division. In the words of Professor Baldwin, "the fact of life history is just what distinguishes an organism from what is a 'mechanical arrangement.'"

While we cannot deny that *Paramecium* is an organism, this fact shows the machine-like nature of its activities. An animal that learns nothing, that exercises no choice in any respect, that is attracted by nothing and repelled by nothing, that reacts entirely without reference to the position of external objects, that has but one reaction for the most varied stimuli, can hardly be said to have made the first step in the evolution of mind, and we are not compelled to assume consciousness or intelligence in any form to explain its activities.

A STUDY OF ANGER.

By G. STANLEY HALL.

Psychological literature contains no comprehensive memoir on this very important and interesting subject. Most text-books treat it either very briefly or not at all, or enumerate it with fear, love, etc., as one of the feelings, sentiments or emotions which are discussed collectively. Where it is especially studied, it is either in an abstract, speculative way, as in ethical works, or descriptively as in books on expression or anthropology or with reference to its place in some scheme or tabulation of the feelings, as in many of the older works on psychology or phrenology, or with special reference to some particular and partial theory as in the Lange-James discussions, or its expressions are treated in the way of literary characterizations as in novels, poetry, epics, etc., or finally its morbid and perhaps hospital forms are described in treatises on insanity. Observers of childhood, like Darwin, Taine, Preyer, Perez, Baldwin, Mrs. Moore, Miss Shinn, Sully and many others sometimes ignore it as too painful a trait to be fully described by fond parents or relatives, or briefly characterize single outbreaks, or special features in a single child. The outlook and the reactionary stages are sometimes confused, and there is nowhere any conception of the vast diversities of its phenomena in different individuals; so that we find not only great divergence but the most diametrical contradiction in describing its typical physical expressions. In some, *e. g.*, Stanley, it is *sui generis* and unique from the start; and for others, *e. g.*, Mantegazza, it shades by imperceptible gradations over into fear and love with few characteristics solely its own. Its physiological basis may be blood composition, digestive or hepatic changes in vascular contractions, abnormal secretions, non-removal of waste or toxic products, over lability of central nerve cells, reflex muscle tension, etc. At present the general subject of anger is a tumbling ground for abstract analysis and *a priori* speculation, which must be gradually cleared up if psychology is to advance from the study of the will to the feeling. Just now the chief obstacle to this advance is strangely enough the Lange-James theory, the general acceptance of which, puerile as it is in view of the vastness and complexity of the field, would do for this general tendency of psychology a dis-service comparable only with that which Descartes's catchy

dictum, that animals were mere automata, did for the advance of comparative psychology in his day.

I have collected the following, far from exhaustive list of English bearing on this state, additions to which in English or other languages also rich in such terms, are invited.

Acrimonious: sharp, pungent, biting.

Aggrieved: made heavy, severe, loded.

Affronted: confronted offensively.

Angry: root *ang*=straightened, troubled. *Angor*, strangling. Angere, to choke, stifle. *Arxio*=throttle. Awe and ugly have the same root, and ache is related, as are anxious and anguish. Other etymologies closely relate it to fear.

Animosity: hostile spirit, more vehement and less lasting than enmity.

Antagonistic: to a foe or adversary opponent.

Antipathy: instinctive and involuntary dislike, repugnance, distaste, disgust.

Aversion: turning from.

Bitter: biting, cutting, sharp, referring to the sense of taste.

Boiling: as a fluid from heat. Temper has a boiling point.

Breakout: restraint or inhibition giving way. *Cf.* *ausgelassen*, not peculiar to anger.

Brood: to incubate, nurse, keep warm.

Chagrin: mortify, keenly vex as at disappointment.

Chafe: as when the epidermis is worn off to the quick.

Choleric: from Latin and Greek, cholera=gall, bile. The liver was long regarded as the seat of anger and of love.

Contempt: scorn, despise, mépris.

Crabbed: scratch, claw, wayward in gait, not letting go.

Cross=curly, crimped, crooked. *Cf.* a "crook" in body or mind, cross-grained.

Cruel: morally crude, and from the same root, pitiless, loving to inflict suffering.

Crusty: brittle, short.

Curt: short and sharp.

Dander up: dandruff, scurf, ruffled temper.

Defiant: renouncing faith or allegiance, and challenging.

Demoniacal: possessed by an evil spirit.

Displeased: designating all degrees of being offended.

Enmity: inimical to an enemy.

Evil: exceeding limits, bad, depraved, vicious, not peculiar to anger.

Pierce often used for anger. *Ferus* (wild savage) cognate with *fera* (wild beast). *Cf.* wild with rage, savage resentment, mad as a hornet, angry as a bull, cross as a bear.

Fight: fighty.

Flare up: *Cf.* blaze out, inflame.

Fit: spasm, convulsion, spell, not peculiar to anger.

Fractionous: fret, rebellious, warmly restive, easily broken.

Frantic: phrenetic, very excited, not peculiar to anger.

Frenzy: same root as frantic.

Fretty: abrasion, corrosion, chafing.

Fume: to smoke. *Cf.* thumos, spirit, anger.

Fury: storm of anger, possessed by the furies.

Gall: ref. to liver as seat of anger.

Glum: frown, stare, sullen.

Grim: stern, forbidding, severe, angry.

Gritty: sharp, grains of sand, pluck.

Grouty: turbid as liquor, dreggy, roily, surly.

Grudge: crumble, crush, ill will and envy.
 Gruff: rough.
 Grumpy: *Cf.* grim and many Teutonic words. Gram=to rage, roar, akin to sorrow, and related to grin, groan, grumble, make a noise.
 Haste: too quick wrath or temper.
 Hate: aversion, extreme detestation, repugnance.
 Hostile: with enmity, antagonistic.
 Hot: warm, heated.
 Huffy: puffed, swelled with rage.
 Impatient: the opposite of patience and long suffering.
 Indignant: at the unworthy or mean.
 Inflamed: a thermal analogy, combustible. *Cf.* flare up.
 Insane: unwell, anger is a brief insanity. *Cf.* mad.
 Ire: irascible, iracund.
 Irritable: excitable, chiefly applied to temper.
 Mad: a mad state, furious.
 Malevolent: willing or wishing evil.
 Malice: malus, bad, with ill will, malicious.
 Malignity: *Cf.* malign, producing malice.
 Morose: fretful.
 Mucky: like muck, nasty, of temper.
 Nasty: used of bad temper.
 Nettled: stung with nettles.
 Obstinate: standing against.
 Offended: struck against.
 Old Adam: aroused.
 Passionate: of any passion but prominently of anger.
 Peevish: feebly fretful, literally crying as a child.
 Pet: *Cf.* pettish, as a spoiled child or pet.
 Petulant: in a little pet.
 Piqued: pricked, stung, nettled, angered.
 Possessed: as if by a bad spirit.
 Provoked: called out, incited to anger.
 Put out: as of gear, off his nut, trolley, etc.
 Putchy: New England for touchy.
 Quarrelsome: prone to contend, also querulous.
 Rage: *Cf.* rabies: a furious degree of anger.
 Rancid: spoiled, tainted, rank, applied to butter.
 Rancor: *Cf.* rancid, something that rankles.
 Raving mad: as a horse, also roaring mad.
 Refractory: breaking away.
 Repugnance: contradiction, fighting against.
 Resent: to have strong feeling against or take offense.
 Retaliate: pay back in like.
 Revenge: requite, retribution.
 Riled: as mud stirred up in water.
 Ructious: (belching) is widely used in New England of angry states.
 Ruffled: hair or plumage tousled or stroked the wrong way.
 Savage: like beasts or barbaric men.
 Scorn: literally mockery, disdain, despise.
 Sharp: used of temper.
 Snarly: as of a dog.
 Snappish: short, crusty, tart, disposed to bite.
 Sore: literally aching, morbidly tender or irritable.
 Sour: acid, mordant, the sours.
 Spite: petty ill will.
 Spitfire: a hot tempered person.
 Splenetic: the spleen was supposed by the ancients to be the seat of anger.

Spunk: tinder, sponge.
 Stark mad: stiff, naked, strongly angry.
 Stormy: violent, gusty.
 Stern: austere, rigid, severe.
 Stubborn: stubbed, strongly obstinate.
 Sulk: refuse to act or respond.
 Sullen: glum and gloomy.
 Surly: doggedly rude, rough.
 Tantrum: literally=sudden impulse.
 Tart: acidulous.
 Tear: *Cf.* Zorn=rend, destroy, rip, burst, tearing mad.
 Tempestuous: *Cf.* stormy.
 Temper: disposition, hasty of temperament.
 Testy: snappish.
 Tew: used in New England for the fretting of infants.
 Touchy: like proud flesh.
 Ugly: literally horrid, unsightly.
 Up on his (or her) ear.
 Vengeance: *Cf.* vindictive, retribution, revenge.
 Vex: literally to shake, to badger, bother.
 Vicious: *Cf.* vitiated, addicted to vice.
 Vile: used of temper.
 Violent: infuriate, vehement, impetuous, turbulent.
 Volcanic: explosive, eruptive.
 Waspish: sting on too little or no provocation.
 Wild: untamed, undomesticated.
 Wode, wood: Wut=mad, furious, frantic, stirred up. *Cf.* woden wütendes Heer.
 Wrath=cognate with writhe, twist, turn to and fro, and with many words in other Teutonic languages with like meaning.

After a learned and valuable discussion, Chamberlain¹ sums up the etymological meanings of words for anger as designating (1) choking and strangling, Eng. *anger* and its cognates; (2) writhing and twisting, *wrath*; (3) crookedness, curling, *cross* and its cognates; (4) bursting and tearing, Ger. *zorn*; (5) hasty movements, *fury*, Gr. *θυρος*; (6) seizing and grasping, *rage* and derivatives; (7) making a noise, *yelling*, Ger. *Grimm*, Tahitian *riri*; (8) malicious talk, slander, Ger. *böse*; (9) mental excitement, Lat. *vates*, Gr. *μηνις*; (10) swelling, Gr. *όπρη*, Samoan *huhu*; (11) based on the heart, Kootenay, *san-illwine* and others; (12) on the liver, gall, bile, spleen, etc., and other words in various languages based on the stomach, nose, forehead, etc. Helpful as it is, this classification, as will be apparent from my list above, is not adequate. These words are interesting reflections of the ancient folks' conception of anger and are, as would be expected, nearly all physical.

Older medical writers, Gebhardus (1705), Slevoytius (1711), Fickius (1718), Clavillart (1744), Bender (1748), Regenhertz

¹ On Words for Anger in Certain Languages. A Study in Linguistic Psychology. *Am. Jour. of Psychology*, Jan. 1895, Vol. VI, No. 4, pp. 585-592.

(1757), Estrevenart (1788), Beeker (1811) and Regenbogen (1820), discussed the physiological effects of anger, urged its occasionally beneficial and even therapeutic effects. A group of French writers: Hiver (1815), Bemont (1816), Bigot (1818), Sallemund (1823), Boscher (1833), gave more or less elaborate descriptions of its phenomena and therapeutic treatment; and Baunus, Gallot, Husson, Ponte, Schneider and others have described cases of sudden death, loss of consciousness, convulsions caused by it, or have discussed its relations to drunkenness,

H. L. Manning¹ reports a case of rupture of a cerebral artery due to anger at an animal in a stable; compares brooding to a mental canker; thinks it may cause cancer and is liable to foreclose a mortgage of weakness in some organs at any time, urges that anger has the same sense as angina and that people whose temper is very sensitive are very selfish. Pointé² shows how violent anger may cause icterus, hernia, syncope, apoplexy, mania, hysterical attacks, mutism, etc. Many records of similar cures could be gathered from medical journals.

Forensic medicine, since Platner's important treatise on *ex-candescencia furibunda*, in 1800, has dealt with anger.³ Misers are inflamed by loss of gold, the proud by slights, lovers by petty offences by or against their mistresses. Morbid onsets of anger are manias of brief duration, and some forms of mania may be characterized as long-continued anger without objective cause. The impulse is irresistible and there is loss of psychic freedom. Again the provocation may be so strong as to break down all the inhibition that comes from restraining motives, and to cause the mind to be beclouded, or the outbreak may be too sudden for the slower, later acquired, and long circuiting apparatus of control to be set in operation, so that responsibility is lessened or indeed removed. Friedreich also thinks the storm of passion may temporarily obstruct the power of self-direction. Feuerbach says "Murder in a moment of passion is a crime possible for the noblest natures," and he goes on to describe conditions under which the act would not only be justifiable but noble. Rare as such cases are, he urges that crimes committed in sudden anger should have individual study.

The murder of her seducer, by Maria Barbellina (a case so well studied by Hrdlicka), committed in an automatic state not remembered afterwards, was essentially anger intensified to a full and typical epileptic attack.

Rush⁴ urges that the term gentleman implies a command of

¹Journal of Hygiene, 1895, p. 324.

²Gazette des Hôpitaux, 1898, p. 273.

³Cf. Friedreich: Gerichtliche Anthropologie, 1859, Ch. III, p. 20, *et seq.*

⁴The Mind, pp. 331, *et seq.*

this passion above all others, cites Newton's mild words to his little dog, which set fire to the calculations of years: "thou little knowest the mischief thou hast done," mentions a clergyman who demonstrated a proposition of Euclid as a sedative, commends Thetys's mode of allaying the anger of her son Achilles by exciting the passion of love, advises a milk and vegetable diet and avoidance of all stimulants, even the moderate use of which predisposes to anger, advises drinking cold water, and in extreme cases a douche with it, and suggests that if due to weak morbid action wine or laudanum may help.

Savage races often work themselves up to a transport of rage for their battles by dances and yells, and rush upon the foe in blind fury. Sometimes the real fighting begins over the division of the booty with sickening sights of savage ferocity, more men being killed thus than in the original capture of the plunder, and blood feuds may augment the horror of it all.¹ The warrior's face is made up in the most fiendish way, his weapons suggest torture more than death, as do even his ornaments, and his scars are eloquent of the most desperate encounters.

Running amok², common among Malays and in other Oriental lands, has been variously described. An athletic man, who thus gives way to either revenge, religious frenzy, acute mental or bodily suffering, or to the various other causes assigned, often shaves off all the hair on his body, strips every vestige of clothing, oils or greases his body from head to foot, and armed with a dagger or knife runs at the top of his speed, stabbing every living creature he can get at. He runs straight ahead, rarely turning corners, never entering houses, and like an enraged human tiger never stops in his career of destruction, often with his head bent low like a battering ram, slippery as an eel, smeared and dripping with blood, till some one kills or at least stuns him. Formerly, poles with prongs were kept in every village to ward off or pin the Amokers who were far more frequent than now. The attack is not due to intoxication nor are the Malays subject to ordinary epilepsy, but it occurs when pain, grief, gloom, and loss of hope nursed by brooding, bring on what their language calls heart-sickness. When Job was tempted to curse God and die, or when we are goaded to desperation and break out from all the control of prudence and speak or act with abandon, reckless of consequences, wounding friends and foes, the Malay rushes, slashes right and left, plunges into the sea, etc. When medically examined they are

¹I. Thompson: *Through Masai Land*, p. 255.

²The Amok of the Malays, by W. Gilman Ellis, M. D. *J. of M. Science*, July, 1893.

in an excited state which lasts for hours or days, and sometimes with complete amnesia of the crisis. Its onset is very sudden and seems uncontrollable and paroxysmal.

In the Viking Age¹ each champion wanted to become a Berserker (fighter without a shirt). These bravest of men wrought themselves into such a frenzy at sight of their foe that they bit their shields and rushed forward, throwing away every weapon of defence. The berserk fury was utilized, not only for war but for performing hard feats beyond the power of common people. "In some cases this fury seems to have overcome the Berserks apparently without cause, when they trembled and gnashed their teeth." When they felt it coming on, they would wrestle with stones and trees, otherwise they would have slain their friends in their rage. In their greatest fury they were believed to take the outward shape of an animal of great strength and perversity. When great champions went berserking and were angry, they lost their human nature and went mad like dogs. They vowed to flee neither fire or iron, and in days of incessant warfare, died singing their brave deeds, and as they entered Valhalla could hear the lay of the scalds recounting their acts of prowess.² Sometimes in the acme of their rage, the mouth was open and frothing, and they howled like beasts and spared nothing in their course. Afterward they were weak, and calling their name often cured them.

At quarter races in some parts of the south, near the close of the last century, cock fights where the birds were armed with steel spurs with which they cut each other to pieces, wrestlings, quarrelings and often brutal fights occurred. In the latter, for which there were rules, "gouging" was always permissible. Each bully grew a long thumb nail for this purpose, and if he got his opponent down, would take out his eye unless he cried "King's curse." Sometimes ears were bitten off, and the yet more terrible mutilation of "Abelarding" might occur. These practices, McMaster³ tells us, long prevailed as far north as the Maryland border.

The Iliad is, as the world knows, the story of the results of the wrath and bitter verbal quarrel of Achilles with Agamemnon over the priest's captive daughter, Chryseis.

Orlando Furioso, in his long search for his pagan love, Angelica, coming suddenly upon conclusive evidence that she is false to him, becomes frantic, and seizing his arms, rushes to the forest with dreadful cries, breaking and cutting trees and

¹ Du Chaillu: The Viking Age, Chapter XXVI.

² Simrock: Deutsche Mythologie, p. 465.

³ History of the People of the United States, Vol. II, p. 5. I am indebted for this and several other references to the Librarian of Clark University, Mr. Louis N. Wilson.

rocks, destroying a grotto, and often thus terrorizing the country for days, passes raving mad through France and Spain, swims the Straits of Gibraltar and continues his devastations in Africa. For 300 verses Ariosto describes in vivid terms his desperate deeds of supernatural strength. Orlando is insanely mad and is restored only after the paladin and the apostle arrive at the magazine of good sense in the moon to find his soul securely bottled and labeled, which they return and force him to inhale, when he is restored.

Modern literature abounds in description of anger, *e. g.*, the breaking of the bull's neck by Ursus in the amphitheater to save the life of Lygia in *Quo Vadis*; the fights of Prasper and Galors in the *Forest Lovers*; Mulvaney's story in Kipling's *Soldier's Three*, where the conflict was body to body, too close to use bayonet, and the men could only push, kick, claw, maul, and breathe and swear in each other's faces, and knives danced like sunbeams, and cleft heads went down grinning in sections, revolvers spit like cats and black curses slid out of innocent mouths like morning dew from the rose. The brutal killing of Nancy by Bill Sykes; the fight with Squeers in *Nicholas Nickleby*; the conflicts in *Scott*; and from ancient mythology to the modern stage, all shows how all the world loves fighters. Danite, M. D. Conway and many other description of demons and hell abound in descriptions of anger. Volumes could be easily filled with such characterizations.

In Ireland's characterization of the insanity of power,¹ there are interesting descriptions of extreme and morbid anger. When angry, Claudius Caesar is said to have grinned and foamed at the mouth. Agrippa's rage at a rival was so great that after one of them was executed, she had the head brought and opened its mouth. Commodus, by the sight of blood in the arena was aroused like a tiger on the first taste of it. He fought 735 times in gladiatorial games, took pleasure in bleeding people with a lancet, and the companions of his anger often fell victims to his rage. Mohammed Toghlaq had a passion for shedding blood, as if his object was to exterminate the human race. Executioners were always present to kill or torture on the instant those who offended him. His elephants were taught to throw his enemies into the air and catch them with their trunks, and to cut their bodies with knives fastened to their tusks. One who had provoked him was flayed alive, and then cooked with rice, and his wife and child forced to eat his flesh. Others were tied by the leg to wild horses, which ran through forests till only the leg was left. Ivan the terrible was filled with tigerish impulses by every suggestion of restraint. His jester

¹The Blot upon the Brain.

displeased him and he threw hot soup in his face at the table, and then rose and stabbed him. He forced people to kill their wives, fathers, mothers and children. Death did not appease his rage, and sometimes his enemies must sit at the table for days opposite the corpses of their nearest relatives, whom he had killed. He interrupted his devotions to massacre those who had provoked him. In one case some 27,000 inoffensive people were killed before his rage was placated. He killed his favorite son and heir in a fit of anger. Another son, who was killed young, had as a child a passion for seeing slaughter, and killed animals himself for the pleasure of seeing the blood flow.

Mantegazza assumes that man has far greater capacity for pain than for pleasure, and can hate more bitterly than he can love. Love and hate are not only often mixed and felt towards the same person, but may be different degrees of the same emotive force. Anger is an expression of egoism, and vanity and hyper-self feeling intensify it. Infants hate most and most often if their feeding is interfered with, boys if play, youth if love, adults if pride, old age if conservatism, women if their affections are disturbed. Duels in their early stages as courts of honor, and lawsuits and courts of arbitration are attempts to restrain this passion which makes *homo homini lupus*. Religions at their birth are efforts to placate the anger of deities and mitigate the fires of their wrath, for God is conceived as angry daily with the wicked, and hell is hot with his vengeance. A long list of curses, perhaps elaborately formed and ceremoniously launched, and damnatory oaths and obscenities, insulting names, especially of animals, imputing deformities of soul or body may be vents. Anger may emit its own peculiar smell; the first cry of the babe is perhaps anger, and anger may be directed toward self. In great haters the luxury of one moment of rage may be deliberately purchased by years of pain, and a city may be destroyed for a single man. Its strength is shown by the fact that while love is everywhere and always taught, and hate and anger everywhere repressed, the latter are yet so much stronger. It has all degrees from the most bestial fights for extermination up to irony, satire, criticism, coldness, neglect, teasing and many other forms. One can be angry without an object, but if we hate we must hate something. Pardon and its motivation are lightly touched upon, and placation of gods and men mark a higher stage, and the long strain of patience is a noble discipline for this *sæva animi tempestas*.¹

O. Schwartz describes a form of morbid transitory rage as follows: "The patient predisposed to this, otherwise an entirely reasonable person, will be attacked suddenly without the

¹Physiologie des Hasses.

slightest outward provocation, and thrown into a paroxysm of the wildest rage with a fearful and blindly furious impulse to do violence and destroy. He flies at those about him, strikes, kicks, and throttles whomever he can catch, dashes at every object near him which he can lay his hands on, breaks and crushes what is near him, tears his clothes, shouts, howls, and roars, with eyes that flash and roll, and shows meanwhile all those symptoms of vaso-motor congestion which we have learned to know as the concomitants of anger. His face is red and swollen, his cheeks hot, his eyes protrude and the whites are bloodshot, the heart beats violently, the pulse marks 110-170 strokes a minute. The arteries of the neck are full and pulsating, the veins swollen, the saliva flows. The fit lasts only a few hours and ends suddenly with a sleep of from 8 to 12 hours, on awakening from which the patient has entirely forgotten what has happened."

Kraepelin¹ describes morbid irascibility *iracundia morbosa* in born imbeciles of higher grade whose moral nature is somewhat developed and who have considerable school knowledge. On the very slightest occasion, they go off as if loaded into an utterly uncontrollable frenzy of rage, tremble all over, stammer out insults and curses, inarticulate cries, bite their lips and hands, run and butt their heads against the wall, try to choke themselves, tear their clothing and destroy everything within reach, till they are breathless, reeking with sweat, hoarse, and too exhausted to move. Upon the stimulus, the explosion follows with the certainty of a machine. Often such cases maintain a certain orientation and avoid attacking persons, but vent their fury upon lifeless objects as in gestures. Such attacks may last an hour or days, sinking back with a long asymptotic curve of diminishing irritability to the normal. They often have no or slight memory afterward of what occurred, lament their infirmity, beg to be bound or shut up, have all objects with which they could do injury removed. Every even imaginary infraction of their hyperalgeric egotism and selfishness may provoke imperative actions perhaps of brutal passion.

Ziehen² describes the disposition to anger which is often associated with abnormal exaltation of self-feeling as hyperthyaim. In paralytic dementia primary exaltation is a very common intercurrent stadium and is a cardinal symptom of mania. In the characteristic cyclus, the depressive stage more commonly precedes. At the beginning and end of an anger fit the peripheral arteria are expanded, sometimes almost to the point of

¹ Psychiatrie, pp. 125 and 673.

² Psychiatrie, pp. 60 *et seq.*, 141 *et seq.*, 174, 242, etc.

congestion in the face; but at the acme of the explosion they are contracted and palor is most common. Respiration is prolonged and deep, the pulse wave low, the lapse of association is retarded, followed perhaps by an explosive acceleration, there is a decrease of motor-discharge, a stage of initial inhibition, succeeded by one of augmented intensity and perhaps restricted range. The play of motives is reduced, reflection drops out and sensation is applied directly to motives which are rather incoherent and unco-ordinated, and it is the shunting out of the association plexus that causes subsequent amnesia. *Furor epilepticus* is the most intense manifestation of anger. As a symptom of paralytic dementia excessive tearfulness is often associated with it, and may more or less take its place with increasing lability of mood and kind of action, and perhaps facial mimesis gestures and general agitation. Morbid irritability is not infrequent in chorea.

No one has described with such clearness and copiousness of casuistic material as Magnan¹ the slow accumulation of anger in paranoiacs, whom he agrees with Tardieu in calling the most dangerous of all the insane, who, on grounds of a purely hallucinatory nature, steal, insult, shout, without having given any one any intimation of the long evolution of their state of consciousness. Querulants complain of all, suspect all about them of changed feeling towards or of designs upon them. They imagine their friends look askance, are less constant in their feelings, are gossiping about them, or are fomenting plots to injure their business, reputation, etc. All is perhaps increased by auditory hallucinations and slowly the patient feels himself the victim of persecutions and surrounded by enemies with overt or covert designs upon him. Gradually reactionary impulses arise and gather force. The injuries must be resented, the guilty punished, and at length, the persecuted becomes a persecutor now entirely devoted to vengeance. Insults, denunciations, abusive letters, threatening, and perhaps written in red ink or in blood, slanders, murderous attacks and every other means are resorted to for gratify hate. No failure discourages, and then reason justifies all their acts as the inevitable retaliation to long accumulated and extreme provocation. He feels his case to be unprecedentedly and inexpressibly pathetic, one that cries to heaven for an avenger. For crimes thus motivated, when the patient has plainly lived completely into his morbid romance some authorities in forensic medicine recognize either partial or incomplete irresponsibility.

For the Herbartians, whose treatment of the feelings always must be very inadequate, anger burns outward from within,

¹ Paranoia, chronica, etc.

establishes a new apperception center, or *pointe de repère*, for a part of the mental content, shakes old concepts into wakefulness, and like a tide adds to one plexus of ideas what it takes from another, and has a long and slowly dying out, somatic after effect. Although perhaps at first "sweeter than honey," as Homer calls it, it belongs on the whole to the algesic and depressive group of emotions.¹

Stanley² characterizes anger as more offensive than defensive, as aggressive, expansive, as peculiarly developed in the carnivora who are usually solitary because predacious habits require a wide subsistence area. Its origin marked a most important and epoch-making era, as important for psychic morphology as the vertebrate form, giving those animals that acquired it a great advantage over those which did not, and it is a great factor in the evolution of personality. Those creatures who can injure all their enemies, and men who make their acquaintances fear to make them mad, are more likely to survive. The greater and more formidable the foe the more fear expels anger and prevents its ebullition. In a certain stage it is wise to bear in mind that any friend may become a foe. The weakness, which instead of hitting back turns the other cheek, is at a certain stage a disadvantage. Weak people cannot hate or be very angry. It is a unique passion, complete, and a genus by itself from the start, and so must be known introspectively or not at all; is pure at first and its hybrid forms evolve later. Its organs are claws, fangs, horns, spurs, and weapons, and it tends to culminate in eating the adversary, sometimes even in anthropophagy. Hate is habitual anger and is retrospective, while anger is prospective. It represents a wild state before and below civilization which has domesticated man. Even lower animals are very sensitive to it in men. While it smoulders and even when it breaks out the intellect may look coolly on. It cannot be undirected, but must always have an object.

For Ribot³ anger in the offensive form appears early (two months Preyer—ten months Darwin), and in its motor forms is the partial contraction of muscles, which are fully active in combat, involves fascination for the sight of and suffering, and in the depressed form passes over into hate and easily becomes morbid, and even epileptic and maniacal. Irresistible destructive impulses are disaggregated forms of anger, and show gradation separated from each other by imperceptible stages from pleasure in torturing and killing to satisfaction in reading of

¹ Volkmann: *Lehrbuch der Psychologie*, Vol. II, p. 390.

² *Evolutionary Psychology of Feeling*. Chapter X, p. 127.

³ *Psychology of Emotion*. Chapter III. Anger.

imaginary murders in novels, etc. All destructive impulses are at root one, and heredity and education, environment and circumstances develop them into determinate, habitual, and chronic directions. It may increase the ptomaines and cause auto-intoxication, and in the lower animal forms whose bite when angry is poisonous, and in human beings modifies the lacteal secretions of nursing mothers. It is best inhibited by fear, in some sense its opposite, and best seen in some carnivora.

Steinmetz¹ holds that revenge is a reaction to enhance lowered self-feeling, and primordially it is not directed against the aggressor, and Ree thinks it a reaction against the feeling of inferiority inflicted by another. At first there was no discrimination, and wrath might be wreaked upon any one, innocent or guilty. In a later stage, upon this theory, it is less indiscriminate, and some fitness is demanded in the victim, as in cases of blood feud. Last of all it was found that the wrong doer himself should bear the punishment. An Indian kicked out of a store kills a family of pigs; a relative at a funeral cuts himself "in a fit of revenge against fate" or kills some poor or defenceless person; the Navajoes, if jealous of their wives, kill the first person they meet; if one dies from an unknown cause, a victim is selected by lot, or the friends of the dead man kill the first person they meet, the bearer of bad news may suffer. All these facts and theories are combated by Westermarck² who urges many cases where carefully directed revenge is exercised by animals. From the very lowest forms anger is aimed at the cause of the pain. This weapon against injustice and injury resents aggression by counter aggression, and is thus a great aid in self-conservation and self-forgiveness. Even common tribal responsibility is a protection against the tendency of revenge to single out the guilty person. The forms and details of punishment are often elaborated.

After teaching this subject many years and with increasing dissatisfaction, I determined to try the questionnaire method and accordingly, in October, 1894, the first of an annual series of topical syllabi on Child Study, which have been continued now for four years, was published on anger and sent to nearly 900 teachers, parents and others in this country and elsewhere. It was as follows:

The phenomena wanted are variously designated by the following words: wrath, ire, temper, madness, indignation, sulks, sourness, pugnacity, crossness, cholera, grudge, fume, fury, passion, to be or fall out with.

¹ *Ethnologische Studien zur ersten Entwicklung der Strafe.*

² *Mind*. N. S. VII, 1898, p. 289.

1. Add any other *terms* or any euphemisms, or phrases you know or can get from children indicating their feelings.

2. Describe every vaso-motor symptom, such as flushing, paling, about forehead, cheeks, nose, neck or elsewhere. Is there horripilation, chill, shudder, tremor, prickly feeling, numbness, choking, twitching, sweating, if so where and how long. Are there any accompanying sensations of color, flushes, taste, smell, noises, (question for each sense). Can blood pressure be tested?

3. Describe all changes of muscle-tension, scowling, grinding teeth, opening lips, setting of eye, clenching fists, position of arms and attitude of body. Is there nausea or a tendency to either contraction or relaxation of sphincter muscles which control anal or urinal passages.

4. Describe overt acts, striking (how, down, straight out, with fist or palm), scratching, biting, kicking. At what part are blows or attacks aimed.

5. What is the degree of *abandon* or loss of self control? Is it complete and is the rage entirely blind, or usually is some restraint shown in intensity of blows or some consideration in the place attacked?

6. Describe long delayed anger, the venting of secret grudges long nursed, and deliberately indulged.

7. Describe intensity curve of quick and slow children.

8. Describe reactions, afterwards physical, mental or moral, whether lassitude, contrition, and all verbal or acted signs of regret.

9. How do children speak of past outbreaks of anger in themselves, and of anger in others, and in general?

10. What treatment have you found good, and what palliatives do irascible children apply to themselves?

In description be photographically objective, exact, minute and copious in detail. Tell age, sex, family life, temperament, nationality of every child. Add to all a description of your experience with anger in yourself, and if possible get a few of your adult friends whether good or ill tempered, to write theirs, or organize a little circle of friends, mothers, teachers, neighbors, to talk over the subject and to observe in concert. Above all, get children of different age and temperament to talk confidentially, or better to write their own ideas in response to such questions as tell some things which make you angry; when do you get angry easiest? how do you feel and how act, how check it and how feel afterwards? write cases of others getting angry in detail, and state what you think about it generally.

This is a subject of obviously great importance for moral and even physical education, but there is almost no literature worth reading upon it. It is so vast that it can be best explored by concerted effort. The undersigned desires to investigate the subject and invites you to co-operation by sending him any notes, however incomplete, upon any aspect of the subject. Or, if preferred, you can start with these hints and work out your own data and print your conclusions.

Let us try the concerted method of work and in some way pool its results for the mutual benefit of teachers and for the good of the children we all live for.

In answer to the above questionnaire, a total of 2,184 returns have been received in season to be included in the following report. Miss Lillie A. Williams, of the Trenton (N. J.) Normal School, sent returns from 244 persons, of which 121 were original observations of children, 92 were reminiscences, 28 information received at second hand. Principal E. H. Russell,

of the Worcester (Mass.) Normal School, sent 109 returns; 35 of which were reminiscences, mostly by his pupils and teachers, and 63 were original observations on children. Mrs. Grace B. Sudborough sent 1,016 answers to the questions with opinions upon hyperthetical stories involving anger. From an anonymous source, 147 carefully written but brief essays upon personal experiences with anger were received. Miss Carlisle, of Norwich, Connecticut, sent 95 papers, partly studies by her normal class and partly answers by school children. From California, 65 papers were received; from an unknown source, 59 papers; from Miss Clapperton, of St. George's Training College, Edinburgh, 77; from Miss A. E. Wyckoff, of Brookline, 72 personal papers; from the Springfield Training School, 24 papers; from Dr. F. E. Spaulding, Superintendent J. A. Hancock, Miss Pedrick, Miss Flora J. White, a few papers each; and from Miss Hughes, then of the Cambridge (England) Ladies' College, 31 carefully prepared papers by students, with others from other sources. Besides this, a large list of literary references have been gradually accumulating during the past five years; the subject has been made several times a matter of discussion in my weekly seminary for the comparison of experiences; and I have several times worked over portions of the subject in the form of popular and class lectures. I am under special obligations to Principal M. H. Small, of Passaic, N. J., lately my student, for the compilation of a part of this material and the selection from the mass of material of some of the typical cases.

It need not be repeated, that, as I have already said, in compiling such material, too much caution cannot possibly be exercised. The returns are of all degrees of merit, from extremely good to worthless, and it requires great and constant critical acumen to sift the chaff from the wheat; and the value of the work depends chiefly upon how accurately and thoroughly this is done. The great advantages of this method are also obvious in the data upon this topic, for the range of individual differences is vast and the fecundity of human nature in so diversifying the expressions of this sentiment is perhaps nowhere more apparent and gives constant and often deep interest in reading over the returns. Concerning no subject have I felt more strongly the necessary limitations of individual experience and how absolutely necessary as the basis for any valid psychology of the subject, it is first of all to gather a vast array of facts and cases. This and the necessity of revising current theories upon anger will explain why I introduce so many condensed accounts of concrete cases. This tends to bring psychology back again into the closest contact with a large group of the most vital facts of life and to rescue it from the narrowing and

one-ended influences of theories from which that part of it which treats of the feelings and emotions and which now seems next in order for investigation, is now so gravely afflicted. The aspects of anger are very many sided and complex, but we see here the intensity and bitterness of the struggle for survival in the past by the traces that are left in modern life. So inadequate and partial are the text-book characterizations of it that it seems well to begin a closer look at this most intricate salient group of phenomena as particularly seen in self and others.

A. GENERAL.

1. Scotch, F., 20. When in a real passion a torrent seems to rush through me with terrific force, I tremble violently and feel quite faint. When the storm is not too deep for speech, I say the bitterest things that I can think of, though often aware that I shall repent them afterward. Yet I always want to be by myself, not to listen to reason, but to stamp, beat myself and think or say all sorts of wicked things. Above all I pity myself most intensely and end in a torrent of tears. A most aggravating fact, however, sometimes is that I cannot utter a word, no matter how eloquent I feel I ought to be. The storm within is too furious for speech, although it always ends with rain. The tears are a sign of exhaustion rather than repentance. The fits last a few moments, rarely half an hour, and to give them vent clears the air. By restraining it I feed on it and it lasts and rankles. If my anger is less violent I avoid speaking to the persons or ignore their existence, but my icy silence will melt despite my resolution. It kills love and admiration however.

2. M., 31. My capacity for anger is great and deepens into indignation, scorn and contempt. I can despise in a way impossible before. To think and to say inwardly that my antagonistic is a — fool vent-my feeling, sometimes I pity him and yet know I shall revert to feeling him a fine man. I am usually good natured, but can imagine causes of anger in those I love, but nothing less than their entire annihilation or that of the whole world, including myself, can satisfy. I believe I should have the courage, fatalism, criminality or whatever it be, to follow my impulse of the moment. My capacity for anger has increased with the breadth of my psychic life, but such periods are far rarer and it takes more to rouse it. Now I sometimes feel a sort of pleasure in bad treatment which was expected to enrage me.

3. English, F., 19. When angry I feel all of a sudden burning hot, stifled and compelled to make a noise. I used to strike people, now I strike things. I used to be promptly carried to my room, now I seek seclusion of my own accord. I used to shed tears, now I feel burning and choke till my nose bleeds, then I am better. Sometimes I grow icy cold and feel as if I was all blanc mange inside. This feeling is worse than the heat, for I seem to be a stone. People speak to me but I do not move; question me but I do not answer. They think I am sulky. I am not, but am simply frozen. I awake the next morning with a sense of shame; relief, however, predominates, then I can look at things in the right light and I go around apologizing and setting things right.

4. M., 30. When angry I feel as if my features were distorted, as if it were cowardly not to look the offender straight in the eye as pride impels, although another impulse inclines me to invert my eyes in an embarrassed way. I am conscious of my mouth and do not know

how to hold it, but this gesture makes me feel ashamed and restrained. I do not know how to hold my hands or to stand, but feel conscious of my whole body, want to be left alone, and when I am by myself I relax from this strain, then I seem to go all to pieces. I collapse, flop down all in a heap, suffer chiefly from mortified pride, feel that I could do almost anything rash, but from this state of utter abandon to later self control I get back in time. When angry I never can talk without crying.

5. Scotch, F., 22. I feel when irritable like a volcano liable to burst forth at any unconscious touch. I used to feel on fire inwardly. It is most painful and urges me to break or knock something down. A casual remark or even a most trivial happening increases it. I do not scold or rant but gather up all my force into a few cutting, cruel words. There is always a faint background of knowledge in the very height of the storm, that words remain forever and that the good Lord I profess to follow disapproves; but all these are beaten down and although I know that my words hurt both others and myself, I must utter them. From about 12 to 16 I would do almost anything to wreak vengeance, often striking people. I feel quite capable of killing a person. Even now I sometimes fear I shall do so, although as a rule my rage vents itself more and more inside. The humorous side of my anger often strikes me afterward, and then its sting is removed.

6. A girl of 10 became so angry because detained after school that she lost all control and gave up to a fit of passion. Her face became very pale, then flushed to a dark red, purple spots came and went on her cheeks and forehead, she writhed, twisted, screamed as though in bodily pain, and at times was almost bent double. At other times she would sit still a moment, gasp, shudder as if to choke, and then begin to scream again. She seemed to be sick to her stomach. She never showed any regret. She was once very angry at me and will always dislike me.

7. M., 44. When huffy or in a tantrum, a man I know has a vein in his forehead swell out large; a woman of 60 lengthens her upper lip; a woman of 25 pushes forward both lips; a college girl I know stiffens her under jaw, her eyes grow glassy, she raises her head, walks stiff and erect, talks in a jerky way which she calls sputtering. Hop-ping mad is a phrase literally correct for some.

8. M., 39. In some, I know, anger makes the face white, the features are set, then a chiselled look will appear beautiful in a way. Others pitch their voice low and speak more slowly and distinctly. The face of one child I know is completely changed. He looks wicked and like an animal. I have several times seen this, it haunts me and I hope I may never see it again. The cause in this case was unjust and ill judged punishment.

9. F., 21. I saw my little wiry music master, a man of 70, thoroughly angry once at my wrong and careless playing. He danced all around the room, stamped, shouted, stammered, and left the house unceremoniously. Some friends passed him around the corner rushing and muttering. At his next visit, mother asked him how I was getting on. He said I was doing splendidly and was his favorite pupil, and that he liked to have me give him trouble, because it showed that there was something in me.

10. F., 20. A sensitive, overworked middle aged music teacher, with keen artistic nature, when angered by laziness or conceit in his pupils, becomes extremely and frigidly polite,—by this, by his sarcasm and a slightly strained laugh, his indignation can be detected. Strong as his temper is, he has it under such control that a spectator would not suspect it.

11. M., 31. A most temperry women, I know, with a tremendous.

will, which if crossed makes her talk rapidly and recklessly. Her eyes flash and I have known her to kick people and strike them in the face. She seems like a dog run mad. If she really hurts people or they are quite upset, her rage instantly goes, and she is as tender as a mother, but afterwards she has a bilious headache. She often justifies her acts afterwards in cold blood.

12. M., 21. The best case I know is a woman, who overwhelms people with abuse, sometimes flies at them, becomes hysterical and then sulks for days. Once she resented her sister's language and destroyed every present she had ever received from her. She considers her temper a matter of course and seems to make no effort to check it.

13. F., 17. An ugly little Italian girl of 15, with beautiful hair like spun silk, of which she was inordinately vain, flew into a rage terrible to witness when it was towed, which the girls took delight in doing. She said little but a terrible demon seemed to seize her and drive her into a passion. Every vestige of color left her face, her eyes glittered and her expression was almost inhumanly wicked and cruel. With one quick look at her tormentor, she would spring at her with feline alertness, and generally left distinct marks of nails and teeth. I never saw signs of regret. "It is to be hoped that her face was covered with blessed shame and that humanity suffused with cooling streams that fiery spirit."

14. F., 38. When angry my face grows pale, but dark about the mouth. I feel numb as if my circulation and physical functions had received a shock. The angrier I am the tighter grows the muscle tension everywhere. Every attack of anger is followed by constipation and urinal continence, also lack of appetite, thirst, nausea at the very sight of food, and also an acute bilious attack. Nausea once lasted six months because I had to sit at the table with the object of my anger; no monthly sickness in all that time. It is ten years since, but the sight of that person still brings on a feeling of anger. Of contrition I know nothing.

15. I saw a gypsy man and woman fighting, screaming, and using the most awful threats. They tried to bite, choke, seize each other in all tender parts of the body, and seemed not human but wild beasts.

16. F., 34. A South African girl, if told to do anything, instantly and ostentatiously disobeys, and calls a long string of names. She reminds me of Angelica in the Heavenly Twins; is honest, affectionate, generous, fond of mad pranks, is capable but hates work, and sits for hours doing nothing.

17. Am.; adult; female. "I do not remember getting violently angry but once. A friend of mine spoke unjust words of a neighbor of whom I was fond. I stood it for a few moments, then I commenced to talk. I could not say things sarcastic enough. There was a lump in my throat. My eyes felt as though they were open to their widest extent; my face was cold; breathing rapid; muscles contracted, and my hands were clenched. I scarcely heard anything. In an instant all this passed. The blood began to be pumped up through the arteries in the neck in powerful pulse-beats and my heart seemed to fairly jump. Gradually the muscles relaxed and a feeling of extreme fatigue came on. I could scarcely walk home I trembled so. When I was in my own room the tears flowed copiously. For a time I was almost afraid of myself. That night there seemed to be something pushing me on which I could not understand. I was very tired when this occurred."

18. F., 38. I teach a boy of fine American parentage who, when reprimanded, parts his lips slightly and looks me straight in the eye a little as though he were laughing at me. When I call him he comes, but sets his teeth, bends forward, clenches his fists, tries hard to speak but cannot utter a word till he cools down and then he stutters,

which he does at no other time, and at length the tears come. He is very bright, excels in study, likes and quotes me on all occasions. He is much worse at home and his mother fears he may become a murderer. He never shows regret.

19. F., 19. A girl friend has a peculiar sneering smile, which curls her lips, and no rebuke or threat can alter her. There is a peculiar contemptuous expression in her eyebrows. Her silence is dogged for days, it is as firm as a rampart against friends or foes. It ends in some burst of defiance and is usually roused by blame. Severity increases it. This disease the poor patient seems to inherit from her father.

20. M., 30. I know a young man of 24 in the West, who is well, strong and sane, whom I have seen repeatedly go to the corner of a ball-room and lie on the floor and pound his head on it and roll from anger, because another man danced with his best girl. He drives cattle and sometimes literally cuts a pig open with his great two-handed hog whip, or rides up to it on his broncho, seizes it by the hind legs and dashes its brains out on the ground. He is generally voted a good fellow, says little and never attacks human beings, but only writhes when angry.

21. F., 24. My former chum was a well-born girl, but without discipline and could never be crossed. If this occurred, she seemed at first astonished and then frozen up with rage. She stood once two hours without moving hands or feet, her head thrown back and a fixed determined look in her eyes.

22. Pure anger makes me creep from head to foot. I never want to have it out with any one or be revenged, but feel haunted and discordant for days. I must be alone, and have my door locked, with no possibility of intrusion, and often pile all the furniture against the door and then sit or lie down to have it out, or perhaps cry myself to sleep.

23. F., 21. When I had once lost control of myself, I wanted to push away everything that happened to be near, to make myself alone, where I could muse on my wrongs and grumble to my heart's content. Whoever happened to come near had to bear the brunt of my growls and hear everything and everybody described in the blackest of colors.

24. Eng., F., 21. In rage some people undergo an entire change, and their eyes grow large and set, the face is rigid, they contract the brows. Some vent it in violent motions, in quiverings of the body, compression of the lips, or bad words.

25. F., 19. I have seen men ordinarily sensible speak with cruel sarcasm and grow absolutely infantile, diffusing bitterness all about, and at the smallest provocation in a game of croquet.

26. A lady of 40 occasionally loses all control. She slaps, dances, says the most cutting things, for she is a woman of remarkable intelligence, but never shows any compunction.

27. My girl when angry is almost insane and acts like one possessed. She attacks anybody, breaks windows. Her second dentition seemed greatly to aggravate her temper.

28. F., 39. A girl of 11 when provoked throws down whatever she has and rushes at her enemy. She is hot, her teeth are clenched, and she usually goes for their hair, and when carried away, she stamps and cries boisterously.

29. M., 22. When maddest I used to sulk, make faces, stamp upstairs, my neck and ears would burn, my teeth grind, my fists clench, and although I felt contrition sometimes, could never show it.

30. M., 29. A girl of 17, humored and sentimentalized can bear no cross to her inordinate conceit. Her anger makes her eyes set and glassy, and she does outrageous things and ends always in sulks with no remorse.

31. Eng., F., 23. Some show temper by being bearish and boorish, others swell up and strut, will say or speak to any one, or give snappy answers. I think that rage makes red people white, dark people browner, and pale people pink. The better the complexion, the greater the change of color.

32. F., 36. I can recall but three violent experiences of anger. I felt pent up and congealed, then the worst of my nature came out. I got dizzy and my head felt very full. I seemed to tremble inwardly.

33. F., 25. Anger makes me hot, sticky and sweaty. I talk fast and loud. In extreme cases only do I completely lose all self control. It always ends in a shower of tears.

34. M., 18. When very mad I used to shut my eyes. There are some people I long to maul unmercifully, also cats, of which I have a most particular hate. The boy I am maddest at has separated me and my best girl, probably forever, and I am laying for him, if I have to hang for it.

35. F., 20. The slightest provocation in the way of getting worsted in games, or being forced to do hated things, made me scarlet and crimson. I still long to break out but something restrains me. I cannot bear to have any one speak to me in this state, and if they do am likely to burst forth in a torrent of tears. My reactions are usually penitence and fatigue.

36. A colored deaf mute, a boy of 15, slow mentally but well developed physically, resents everything, but most of all, allusions to his color. He shakes his fists, his eyes bulge, his upper lip is drawn from his eye teeth, he grows blacker, draws his fingers significantly across his throat, and his gestures and threats are terribly in earnest, but it all goes off in this way and he harms no one.

37. F., 21. There are no special causes or times that put me in a temper, and yet I sometimes have to walk up and down on tip toe or march back and forth in the garden or brace myself to sit still, feel every nerve and muscle stretched to its utmost tension. Sometimes when I am angry at people, I incline to do all the little nasty things I can think of to them, and the more angry I am the more lacerating things occur to me. Sometimes I cannot say these things, but fear that I may do them.

38. One bonnie merry Irish girl has spells of mood, during which she hardly speaks, but her moods are so separate that in one she rarely refers to the others.

39. F., 19. When alone I roll, wriggle and weep, but keep up a kind of philosophizing all the time as to how the object should be treated when we met.

40. F., 23. When my hot and furious temper culminates, I tremble, am cold, and speak out recklessly the first and bitterest things I know.

41. F., 19. A girl I know bursts into a flood of passion and must make a noise in almost any way, then she passes into the sulky state, and it takes a day or two for all to vanish.

42. M., 31. I know an impatient person who first fidgets, nostrils begin to twitch, eyes glare, voice is raised to a crescendo and after the acme there is a diminuendo, as the rage subsides. I know some whose chronic state of mind is sour and nothing is right.

43. Am.; adult; female. When I get very angry my face grows white, and it seems as though a cold hand clutches my heart. I grow faint and dizzy, and see green and black and red all whirling together. My breath grows short and my body gets limp. There is a distressing feeling of nausea. If a person ill treats me further, I rouse up and feed him sand, whereupon these symptoms disappear.

44. A boy of 14, the terror and leader among the inmates of a State reform school, when angry looks the person, officer, superintendent,

or whoever it may be, firmly in the eye, calls him the vilest names, is outrageously profane and attacks them like a mad man.

45. F., 23. If I could not have my own way when I was a child, I would scream and jump up and down. There was no control until I was about 8, when the form of my outbursts became tears and angry words. I had to do something when in a pet if only to rush about.

46. F., 26. My temper takes the form of taking things amiss and not being pleased at anything, am silent and gloomy, with a feeling as if my head was fixed in a vise. This symptom is a warning and the sensations are so painful that I make a desperate effort to keep pleasant.

47. My mother is a most warm hearted and affectionate woman, but when angry says very cruel things, which one does not like to think of. She has not been the same person since my little brother was born, and imagines injury where there is none, and broods over and nurses her wrath to keep it warm. My father too is hasty and like a great child in the way he takes offence, but he does not brood like mother. I have inherited his type.

48. F., 30. I have no feeling and no mercy, but will have my own way and prevent others from having theirs if I can.

A few typical individual outbreaks:

1. A big girl in a country school told me to get up and give her my seat near the fire, and when I refused she sat heavily in my lap. I could not push her off, and soon without willing to do so, found my teeth set pretty deep in her back. How often I have wondered if I did right. The question loomed up into big proportions and haunted me. I thought over and over again, "she was biggest, I had the seat first, what else could I have done," etc. I cannot tell how great this question grew or how it hung like a pall over my life for years.

2. F., 45. Once I was angry with God. It was too dreadful to recall; a sense of helplessness, the futility of reviling or opposing him, and this added to the horror. I was ill and could not hold my peace, but had to look up to the sky and blaspheme. My brother had a similar experience and told me that he felt as if the foot of a giant was on his neck. I told a clergyman, who called, to leave the house, that the Bible was a volume of lies, and God was the worst liar, for he had deceived me all my life. I have repented since and trust I am pardoned.

3. M., 40. Once I was said to have pushed down my brother, who was badly hurt, although in fact I was at the other end of the garden. I would not say I had not done it, and so was kept in bed two days. During this time I read Gulliver with delight, but a strong background feeling of injustice was always associated with this book. I am still angry at every thought of this, although usually I am quick over my tempers.

4. About my last rage was at the age of 13. I was in bed, and my sister was long in undressing, and then left the lamp in the farthest corner for me to put out. We quarreled fifteen minutes; then I put it out, but when I got back to bed, pinched her, when a fight ensued, which resulted in both of us sleeping very uncomfortably at the opposite and cold edges of the bed with a bolster between us.

5. F., 48. In youth I took refuge from the very few crosses of my very guarded life in pride. The first real anger was at the age of 42 at an act of injustice to my son, which stirred me fathoms below all previously known soundings in my nature. Each time that I permitted myself in the sanctity of friendship to discuss the matter, a singularly vile taste would arise in my mouth followed by extreme nausea.

That mighty maternal instinct of protection, which runs through all higher animal creatures, has since then been far more clear to me.

6. F., 41. My older brother teased me until I said I wished he was dead. As soon as I had said this dreadful thing, I was terrified lest a judgment from heaven should fall upon me by causing his death that day. I watched anxiously when he returned from his work and recall my remorse far more distinctly than I do the anger.

7. M., 24. I began a boyish fight which lasted nearly an hour without anger. It ended by my enemy falling and pretending to be dead. I believed he was and felt exultant and perfectly satisfied and happy. Left him lying at the fence corner and went home. Knew I must suffer at the hands of the law, but was fatalistically resigned.

8. F., 46. When I was ill and the doctor came to tell me of my brother's death, I struck him with all my might; and all that is usually grief seemed for the moment turned into anger.

9. F., 24. My last great rage was eight years ago at my brother who hurt my cat. I rushed at him, screamed, thumped him with both fists as hard as I could, then I ran out of the room, cried, felt ashamed, pretended to act as though nothing had happened, and for a long time felt hot and miserable, for my brother kept alluding to the wounds he said he had received.

10. F., 45. A slum boy lately struck me in the face with his fists. My face grew icy cold and all my muscles got tense. I felt my lips white and wanted to hurt him physically. I could have done it, although he was a large boy, and should have done it but for my dignity as a teacher. I wanted to put him on the floor and pound him.

11. M., 37. My present temper is of three sorts—first, actual passion; second, impatience or ire; third, sulks. Of the first I can recall but two instances. One was when my little brother would not stop teasing me to show him something when I was very tired. I broke out in words and was checked by the look in his face. I could have cried as I could at this moment in remembering it. When a friend urges me to do something I abominate, I have several times measured strength with him.

12. M., 23. Once when I was about 13, in an angry fit, I walked out of the house vowing I would never return. It was a beautiful summer day, and I walked far along lovely lanes, till gradually the stillness and beauty calmed and soothed me, and after some hours I returned repentant and almost melted. Since then when angry, I do this if I can, and find it the best cure.

13. F., 43. When about 4 my brother shot an arrow at my candlestick, this made me so mad I ran out of the house and hid under a hay stack, resolving to make him miserable by being lost, and determined to die from starvation.

14. F., 20. I offered a doll to my little niece and when she reached for it, I took it away and told her she could not have it. It worked like a charm, and when she was brought up to the proper pitch, I took the following notes—face very red and swollen, two deep wrinkles between the brows, lips firmly pressed together but later open to their full extent, when she began to scream at the top of her voice. She stamped, kicked, tried to slap me in the face and clenched her fist. Later but not at first the tears came and she sobbed as if her little heart would break. Next time I shall study her laugh which will be a pleasanter task.

I. CAUSES.

The following cases selected and abridged from many are typical and suggest that women have more provocations than

men, but usually practice control better, and how courtesy, respect, sympathy, consideration, kind and fair treatment of others and even of animals may remove many of the incitements to it.

1. F., 20. The painful feeling at the time and the self scorn afterward make angry experiences hard to recall. The chief causes are contradiction, especially if I am right; slights, especially to my parents or friends even more than myself; to have my veracity questioned; the sight of my older brother smoking when we are poor; injustice, dislike or hate from those who fear to speak right out; being tired and out of sorts, etc. In the latter mood the least thing like finding books out of place; loss of step when I am walking with some one; indignity to a poor girl by the teacher; stupidity in people who will not understand—these make me feel as a cat must when stroked the wrong way. Injustice is the worst and its effects last longest. To be distracted at my work; unpleasant manners and books; hunger and cold; to be treated as if I were of no account; flies that will keep lighting or buzzing around me; to stub the toe or have it stepped on; to forget things that I want to remember or to be unable to find things; when my bicycle hits a stone; to have lost a button or have my hair come down; to have a pin come out or my clothes rip; these things make me more petulant.

2. F., 26. People more than things or events arouse my temper and some have far greater power to do so than others. Their mere presence is so irritating that it requires a great effort of control and my aversion is often apparent to others. Life with such persons would be intolerable, and would bring out the worst side of my character. Special causes are narrow mindedness, cruelty to animals, slander, obstinacy in thought and deed, want of sympathy or sometimes a trifle unnoticeable by others, touches the sore spot, times of ill health, being forced to do over what I had done as well as I could before, times of low spirits which with me alternate with high. I pay too much attention to details without grasping the whole, and this makes trifles irritate me. I jump at conclusions and hence am often angry without cause.

3. F., 29. Whatever limits my freedom of action or thought is the strongest stimulus to wrath. I was royally mad at my sister because she did not resent an injury. I can deny myself as much as others can, but cannot endure to have others cross me. I was never madder than when my brother would make a noise, when our mother was ill. My causes are girls talking out loud and distracting me in study hours; to be accused of idleness when I have studied my hardest; blamed for what I did not do or did, or my health being below par. Sometimes when I am happy, I am more easily angered than when melancholy, because in the latter case everything looks gloomy, so that one point more or less makes no difference.

4. English, F., 22. I have a great variety of tempers, especially of the irritable, jealous, sulky violent kinds. The violent kind is caused by injustice to others or extreme flat contradiction, or when my favorite, deepest feelings and will are thwarted. The irritable type comes from smaller stimuli like being kept waiting, being hurried, having my skirt trodden on, density in others, etc. Health also affects it. Jealousy is caused by those I dearly love preferring others. Sulks are due to neglect or injustice or impertinent coldness. All these types except the irritable are more under control than in childhood.

5. F., 20. If accused of doing what I did not, and especially what I abhor, I am so angry that I tell my accuser that she would do the

same. If I am hurrying in the street and others saunter, so that I cannot get by, or a person I like makes fun of me, or when given a seat in church behind a large pillar, I am provoked, and the more helpless I feel the more ungovernable my temper becomes. Opposition enrages me, so does a discordant note in music, especially if repeated.

6. F., 23. My lines have fallen in such pleasant places, that I hardly know how anger feels; yet injustice does rouse ire which I call righteous. Sometimes I take up cudgels in behalf of imaginary sufferers and work myself into a state of passionate fury. In such mental inflammations, epithets and phrases suggest and form themselves with dreadful facility, and I express myself far more easily than at other times. Sarcasm and criticism are such a relief. If people are perfectly unjust, I can treat them indifferently, but if there is a spice of truth in what they say, I am much more angry.

7. M., 34. When despondent the worst thing is to have made up my mind to do something and failed. Being angry at myself, I am consequently so to all who speak to me. Frivolity in others, asking needless questions, attempting to cajole or boot-lick the teachers, rouse me; so does doing what I do not want to when I vent rage by doing it in a slovenly and discouraged way. Self gratification at another's expense, cruelty, being deceived or trapped, or when dignity, self respect or common courtesy are outraged.

8. M., 28. Am often angry with myself caused by my own faults, my jealousy of friends, so that I can rarely rejoice at another's success. This is bad and I fight but cannot overcome it. An over tidy relative always slicking up my things, the necessity for hard cramming for examination, interruptions, being laughed at is perhaps the worst of all. Being asked to give or do things when I am just ready to do so of my own notion, having my school work soiled.

9. M., 19. My causes are being beaten in an argument, when I know I am right, being misunderstood, being kept waiting, and worst of all being told I am stupid and ought to know better, especially if it is true, being accused of cheating at games, although it takes many such little aggravations to bring me to the boiling point.

10. F., 48. In my teens very divergent opinions or beliefs made me angry. I blush, throb, grow stiff, and have a peculiar whirling sensation in the head. If I differ in argument and cannot convince my opponent, or if he says what is false or strained to prove his case, or worst of all jealousy makes me short, sharp, crusty, and pale and savage in looks.

11. F., 22. The causes of my anger are if people act against reason or their better knowledge, or lack moral courage, pandering of all sorts, seeing nobodies patronized, slovenly work, want of system, method and organization, being expected to do things without the means or conditions, sudden emotions and meanness.

12. F., 25. My causes of anger are slowness in others, being kept waiting and expectant, or being slow myself when I want to be quick, when I am angry at myself. Another cause is if others are dense and wooden, if my curiosity is aroused and not satisfied. Perhaps it may all be resolved into my not having my own way.

13. M., 27. I am angry at late risers in my own house, stupidity, disappointment in some fond hope and feeling pushed and hurried. Any kind of reproof is most irritating. To sharply deny people what they want is the best means of arousing their temper.

14. F., 14. My temper is worst when I see a girl put on airs, strut around, talk big and fine. I scut my feet and want to hit her, if she is not too big. Jealousy at hearing others praised as I think unduly as paragons, or having my own nature dissected or discussed, is most irritating to me.

15. F., 22. Aggression toward the weak, stupidity, obstinacy, lying, deceit, and a sense of impurity. A person I neither love or hate would have a hard task to put me in a temper.

16. F., 36. One chief cause of anger and even fear in children would be removed if we did not begin their training with don't's. Sympathetic and positive indications, if wisely administered, cure me.

17. F., 46. When a playmate said her mother was better than mine, I tipped over the table in her house, rushed home, and was so confused that I fell down stairs, was more controlled afterwards.

18. F., 14. If I am made to stop reading a story in the most interesting part to wash dishes or mind the baby, I have to squeeze something very hard or make faces, and sometimes when very mad, I laugh.

19. F., 14. What makes me mad is if I have a bad headache or my brothers and sisters get to fighting, or all turn and plague me when mother is gone. Sometimes I hit and sometimes say a prayer to myself, and try not to mind it.

20. F. With me it is the worst and the commonest cause to feel that I have more to do than I can, to hear gossip about neighbors.

21. F., 29. When tired, I am irritable and fret at little things, and all my life have felt that I was not understood. This causes me to brood. If I am excited from having enjoyed myself very much, then I am easiest angered.

22. F., 31. To be crowded or jostled, told to do something by people who have no right, to see slovenly work, to be ridiculed, spied, tattled about, be detected in wrong doing, is my chief provocative.

23. F., 19. Harping, nagging, gloating over one's own or others' wrongs, rouses me and I give my friends the benefit of my thoughts with a great deal of volubility.

24. F., 29. Term time with regular work is better for temper than vacation when all sorts of things may turn up, and when there is not system, yet some are most irritable when working hardest.

25. F., 30. Tittle-tattle, petty talk and gossips, flat contradiction, interference with my rights or affairs, impertinence, constant interruptions, practical jokes, idiotic laughter or anything unjust.

26. M., 26. The most provoking things to me are real or fancied slights to those near me or myself, for I have great pride which is easily wounded.

27. M., 22. If indigestion, which is a form of irritability, is temper, then I often feel it. I am easiest angered in the morning, but later in the day can face difficulties with far more equanimity.

28. F., 35. My childish tempests of wrath burned hottest when my grandfather used to trim or cut down trees or even shrubs. I told him God made them that way, and he had no right to hurt or change them.

29. F., 20. Teasing I never minded, but rather enjoyed, but to snub or talk down to me in a top-lofty way arouses all my ire.

30. F., 31. If people I care for say unkind things, it hurts me so I seem to turn to stone, and it seems as if I can never love them more. This rankles. I can recognize one distinct type of my threefold temper, which comes from my mother.

31. F., 21. To have to do a great deal of unnecessary work, which my people invent to occupy my holidays, makes me maddest. I speak sharply, and I have reasons, for I am not a naughty girl, who needs to be kept out of mischief.

32. F., 44. When boys use vile language in my presence, I want to smack them across the mouth. Cruelty to objects incapable of resistance and injustice to children rile me intensely.

33. F., 39. Familiarity, which I have not evoked, discussion with those who have not even tried to understand my point of view, to hear

myself talked about or discussed, even by my parents, is insufferable.

34. I am more indignant at what people say than at what they do. When nasty things are said, I lose control of my tongue and must say what comes into my head at the time. I hardly know what I am saying, but it all comes back later.

Spontaneous Anger. I think we must admit that sometimes this really occurs, although it is a very interesting and uncertain question. Prison and other records show that people in confinement sometimes break out into fits of destructive rage with no apparent cause. Of course dislikes may deepen to antipathy and aversion, till not only every act whatever but the very presence of certain individuals may irritate to the point of explosion, and there may be a long summation of petty vexations, but it would seem that our organism is so made that this form of erethic inflammation may reach its fulminating stage without any cause assignable by the subject or observable by others. Sometimes purely imaginary wrongs to imaginary people excite intense moral indignation. If there are spontaneous cases, they cannot be entirely explained by love of this kind of erethic state as such, but may be due to the necessities of growth or over lability of nerve cells or centers. The satisfaction and real physical pleasure too that sometimes follow anger suggests that it has its place in normal development. Running amuck is sometimes described as spontaneous, like rabies. The determination of this question is like the problem whether crying and some movements of infants and animals are reflex or due to purely efferent causes, is at present insoluble nor is it crucial for the Lange-James theory. Platner, as we saw, thought some forms of mania were best characterized as prolonged anger without observable cause, and the Berserk rage it was thought was sometimes unmotivated. Michael Angelo is described as chipping down a block of marble to the rougher outlines in a veritable rage, and I lately read of a man and wife in court for fighting who agreed that they were peaceable and affectionate but had to have a bitter quarrel every few weeks over nothing to clear the air. Play and mock fights often contain a little repressed anger and are good to vent it harmlessly.

1. F., 23. When I was 17 I had a long spell of irritability, was unhappy, and it gave me pleasure and satisfaction to make sarcastic remarks. My weakness is impulsiveness, which makes me unfit for a responsible position. I try to lay good foundations of belief and get more settled feelings for my own determination.

2. M., 41. A girl up to 17 in good health had fits of anger with great regularity; about once a month she was violent and lost all self control. No small vengeance was her desire, but no less than a passionate desire to kill the offender. Hatred shown by looks and gestures was intense, and the fit might last a week.

3. F., 7, whose mother calls her every endearing name, while describing her way of sitting, eating, speaking, etc., suddenly passes

to a rigid state, and she once on recovering from this vented her spite by cutting off all the leaves of a century plant.

4. Girl of 3 was eating lunch, when suddenly, without discernible cause, she cried out, tipped over her milk, rose, threw herself face down upon the floor, screamed, kicked, beat the boards.

5. A boy of 14 was sitting in school dreamily gazing out of the window when suddenly his face clouded, and scowled, and he struck his fist on his slate and broke it. The loud noise and the teacher and the school brought him to himself. He could give no explanation except that he felt mad and must strike something.

6. M., 31. When a schoolboy I was a great fighter and if I had not had a battle for some weeks was literally spoiling for a fight. Once I went to the barn and pounded a poor cow chained in her stall for relief. Teasing and bullying used to relieve it. I sometimes pounded a rock behind the corn-house with a sledge hammer.

7. M., 25. Anger often helped me out in my work. In chopping wood, mowing, and other things requiring great effort, I could scarcely help gritting my teeth and getting mad with the object. I used often to find myself helped on by anger at sums, knotty translations, etc.

8. M., 37. (Once assistant physician in a lunatic asylum.) I knew an epileptic case where the patient, a colored man of perhaps 25, had fits that seemed to be nothing but spells of blind rage. He would attack every one, destroy everything and injure himself till he became unconscious. He felt the symptom beforehand and was put in a padded cell.

Personal Antipathies Based on Physical Forms and Features.

While these dislikes sometimes are intense enough to generate anger, their chief effect is to raise the anger point, so that a far slighter stimulus is necessary to produce the explosion than in the case of those who instinctively attract each other. From very copious collections of questionnaire material for a very different purpose, it appears that children and young people are very prone to detect resemblances to animals in faces, and often see persons whose features suggest the monkey, dog, parrot, pig, cat, mule, sheep, rabbit, owl, fox, lion, etc., and therefore become objects of special aversion. In another series, prominent or deep set eyes, shortness of stature, cowlicks, ears that stand out, too prominent chin, brows that meet, large feet, high cheek bones, pug nose, Adam's apple, long nose, small chin, prominent, large, dirty or otherwise exceptional teeth, pimples, red hair, light eyes, thick lips, a stub thumb, bad breath, bleary eyes, freckles, fatness, leanness, birth marks, deformities, are features any one of which may evoke immediate antagonism and put the mind in a critical attitude, so that with reference to persons possessing these peculiarities irritability exists side by side with great good temper for those who are physically attractive. Girls in particular often single out some one peculiarity with respect to which they are especially sensitized, and in some cases are provoked to active hate in a way that suggests the converse of the fetishism common among sexual perverts. It is difficult often even for the subject to

analyze the cause of these repulsions and they are sometimes quite unconscious and instinctive.

F., 21. I am a great person to take likes and dislikes; and if the latter, can see no good points in the person. I often judge wrongly and sometimes can conquer my aversion, but it often recurs.

F., 22. My little brother is like me in taking unaccountable aversion to things and persons, especially the former, *e. g.*, a new suit. I have an insupportable aversion to share my room with certain people with whom I like to go around with well enough, so too I cannot see sick people without anger, unless I love them passionately.

F., 19. I believe some persons have elements about them that tend to always keep others bad and others in a temper. The more I like people, the more it takes to make me angry at them; and the better my health, the stronger must be the provocation. Examinations make me spiteful toward the very rooms where they are held, and here some of my worst scenes with Apollyon have occurred. Generally I can stand any amount of banter, but sometimes a little brings a storm on some luckless head.

Based on Peculiar Acts or Automatisms. In this list we have snuffling, lipping, making faces, swallowing, rolling the eyes, peculiarities of voice, accent, intonation, inflection, sighing, shrugging, the kind of smile or laugh, motions of the head and arms, gait in walking, posture and carriage, hiccough, stammering, and bad manners generally.

Dress and Ornament. Ear rings in men to 130 women out of 679, are objects of intense and very special abhorrence. Thumb rings, bangs, frizzes, short hair in women, hat on one side, baldness, too much style or jewelry, single eye glass, flashy ties, heavy watch chains, many rings, necklaces, and a long list in this class show how dominant unconscious forces are in mediating dislike, which in some souls needs little intensification to settle into permanent hate. Not a few young women state that they could never lead happy married lives with the possessors of these peculiarities, no matter how many good traits of body and mind atoned for them, and the presence of persons possessing them is described as a constant source of irritation, sufficient in itself to spoil the temper. Special aversions of this kind must, of course, be the results of considerable development due to frequent or continued exposure, and it is plain that in some cases the antipathy is created by association with other disagreeable qualities. It would be interesting to know, what our data do not show, whether these traits are conspicuously present or absent in those who detest them, for it might throw light upon the question whether similar or complimentary characteristics repel or attract.

Habits. Another class of instinctive aversions for which some minds develop sore, irritable spots, are certain habits like smoking, eating onions and garlic, untidiness in dress or toilet, want of punctuality in rising, meals, engagements, etc., too

rapid or too slow movements, gossip, cowardice, too great bashfulness or familiarity, lying, stupidity or density, selfishness, cruelty to animals, injury to flowers, trees, property, etc., meanness, flattery, affectation, disorderliness, too great primness and preciseness, excessive poise and reserve or deliberation, imposition, laziness, pandering, criticism, cheating in games, and bragging. While individual experience in many cases exposes individuals more to one of the above chologenetic agencies than to others, there are undoubted indications of a tendency to ratty specialization here, so that if education may be defined, as I suggest it may, in part, as learning to be most angry with those things that most deserve it and maintaining a true perspective down the scale, most of our correspondents are not thus educated, and we have here another example of the *res augusta domi* of the mind for which heredity may in part account, but not wholly. The above miscellaneous qualities might be classified as æsthetic and moral. The deliverances of conscience and a good taste are, however, here particularly interrelated. Righteous indignation at unethical acts shades by imperceptible gradations into the milder verdict of bad taste, but even the latter is not without significance as a predisposing cause of anger.

Limitations of Freedom. Liberty is a precious possession and sedulously guarded by instinct. It is the indispensable condition of the completest and most all sided growth, and cannot be too carefully cherished. In an atmosphere of repression and of *don't's*, temper usually suffers, while one of the best cures of habitual anger is liberty, and complete occupation is often a preventive to it.

The Thwarting of Expectation or Purpose. When a story breaks off at the most interesting point and the mind is left in suspense, or when children are called away from stories just before the dénouement or games before the crisis, when they are kept waiting or if curiosity is especially aroused, or they are fooled and deceived, which is one common form of teasing, or if adults fail to realize the plans of their youth, the anger diathesis is called into play. In fact science, which is prevision, and consists largely in eliminating shock or the unexpected, has as one of its functions the reduction of this chologenetic factor. Sudden fright, the blocking of a path or doorway by an obstacle, the stubbing of the toe or running into a post, are perhaps physical analogues of the same thing. We might laugh in some states, if Spencer's theory of a descending incongruity is correct, but we are more likely to be indignant.

Contradiction. Akin to the above cause is that of meeting opposition of our sentiments or ideas. Even when very different views are encountered in friends, especially if they are per-

sistently maintained, as well as when the direct lie is given, the conflict of mind, will or feeling arises, which may evoke the anger erethism. There are paranoiacs to whom not only the thought but the very word conflict¹ or even discussion excites painful symptoms, while the interest in a vigorous altercation or debate, although less than in a slugging match, is very great.

Invasion or Repression of the Self. Each personality hedges itself about with certain limits which, however widely they may vary for friends and enemies, are more or less fixed for each acquaintance or each mood. While many complain of not being understood, a frequent excitant of anger is being too well known. Hence, prominent among the assigned causes are being spied upon, tattled of, gossiped about, criticised, dissected, analyzed, detected or even reprovod. One form of plaguing is to penetrate with undue familiarity, like nicknames, the adytum of selfhood, and mocking and ridicule find part of their effectiveness here. Here, too, belong most forms of impudence from our inferiors and insults from our equals.

Pride and a certain amount of self respect is one of the most irrepressible qualities of our nature, so that slights, contumelies and undue subjection or subordination, even slight wounds of vanity that are inflicted by ostentatious disregard of opinions, are keenly resented.

Injustice. Not only cruelty to animals or persons taking unfair advantage, but injustice to self, like being accused of deeds or words that are abhorred, abuse of friends, heroes, favorite authors, and in rare cases imaginary indignities to imaginary sufferers, are chologenic.

Individual Causes of a Special Nature. Some describe with considerable detail not only as special provocatives but as causes of distinct deterioration of temper, frequent experiences like finding books, utensils, tools, etc., out of place, persistent attacks of flies and mosquitoes, the perversity of walking with those who will not keep step or habitually lose it themselves, of having the toe or dress stepped on, of being jolted in a vehicle, crowded or turning out the same way in meeting others in the street, or even being touched by strangers, having the hair come down or out of order, the approach of a dog or cat, etc., busy work, being given too much to do, taunts, meanness. Indeed most have sore points or anger zones which may be based on individual weaknesses, or on peculiarities of form or action, or on special experiences of provocation.

Jealousy. Jealousy in seeing others preferred by teachers,

¹ See the interesting case described by Dr. E. Cowles. Persistent and Fixed Ideas. *Am. Jour. of Psychology*, I, p. 222.

friends, acquaintances, or hearing them praised, may cause not only intense misery but angry outbursts.

SUBJECTIVE VARIATIONS.

Among these the changes from the general feeling of euphoria and well being connected with good health, which is the best preventive of anger, down to illness and pain, which are its surest promoters, are most important. Some forms of disease and early convalescence are particularly characterized by irascibility, and children who are in abounding health have, other things being equal, perhaps the best immunity from temper. Closely connected with this is the state of rest or fatigue. In the morning after a long vacation, provocation is, as every one knows, far less easy than in the state of exhaustion. Hunger and sleepiness, too, incline to anger, and satiety to good temper. The optimum of temperature helps the disposition, while excessive heat and cold make it fragile. Dentition and menstruation are very important sources of variation of the anger point, which from all these considerations seems to be even more fluctuating than has been supposed. General prosperity and a sense of doing well and getting on in the world, as contrasted with ill fortune and calamity, makes for exemption from anger, as does a general good conscience, settled and tranquil religious opinions, good friends, an optimistic philosophy, sufficient but not too much work or occupation, and in general absence or removal of all the chronic causes of fretfulness. The states of irritable weakness and hysteria are characterized by fluctuating moods, *e. g.*:

Heredity. On general principles it would seem that a diathesis so marked should be as hereditary as anything in our psychophysic organism. While our data are far too few for inference, it would seem that inheritance has here a wide scope.

F., 39. My father was never even hasty, but my mother was of a cranky, temperry family. I am for months and for occasionally years, sweet and placid as my father, and then without provocation I have spells of great irritability like my mother's people.

Eng., F., 11. My aunt who brought me up has given me her quick temper. It came by contagion and I think not by heredity.

Eng., F., 18. My father is the calmest and most placid of men. My mother one of the most fiery of women. I am all mother in this respect.

Eng., F., 20. A young man of 20 I have known from childhood inherits great irritability which can brook no restraint, who suffers to the point of tears from wounded pride, can bear no teasing or reproof, directly from his maternal grandfather. It seemed to lie dormant for a generation.

Eng., F., 23. My mother is very irritable. Her father had a whirlwind temper and five of us seven children have it, and in two it seems quite absent.

Scotch, F., 26. One brother, one second cousin, and one maternal

ancestor are very hot tempered like me, the rest have more or less escaped.

Absence of Temper. Some seem born untempered, nothing flusters or ruffles them. They are passive, easy, lazy, inert, apathetic, and while often imposed upon are generally liked, rarely teased or abused. Such cases usually lack not only energy, but the power of enthusiasm and capacity for erethic states generally. Too good a temper not only precludes from the luxury of intense forms of manifesting life, but is usually associated with a certain insensibility, lack of self respect, ambition and will power.

F., 39. My provoking good temper has been my life-long reproach. I fear it is, as I am often told, apathy, for I am easy going in matters in which I should take more interest. Then, too, my shyness keeps me from showing what I feel deeply.

F., 21. I am by nature rather unimpassionate and indifferent, have little temper or impulsiveness and rarely get enthusiastic. I do not consider this a virtue, but it is not because I am too lazy to show temper.

F., 28. In good health and happy circumstances, I have yet to see a sour spirited child. I think it would be possible to rear many children in such a way that they would have no experience of anger.

F., 29. I know a girl who never in the world could by any possibility be roused to temper. Her temperament was so inert, she says she cannot get up anger when she knows she ought to. A world of such people, I think, would be very monotonous.

F., 27. I often liken myself to a happy, clear, busy, sparkling brook, rarely interrupted by any one stirring the mud at the bottom. I can be roused, however, and the time before normal conditions recur depends upon the depth to which the mud was stirred.

F., 18. I know a girl of very hot temper, who when provoked does not give way, simply and solely because she is too lazy to take the trouble. It fatigues her to control herself.

Teasing and the Cry and Anger Points. Hectoring, plaguing, baiting, worrying and tormenting in all their many forms are largely, though not wholly, motivated by what might be called the psychological impulse to see what another will do under these new conditions of strain or temptation. A German student told me he never felt acquainted with a new man enough to know whether he liked or disliked him, until he had seen him more or less intoxicated. This sentiment is very wide spread, and is akin to Plato's suggestion that counsellors should discuss topics at night, when drunk, and decide them in the morning, when sober; so for many anger removes masks, and what Nordau calls the conventional lies are thrown off and we seem to see the lower strata of what a person really is at bottom alone, or in the dark. Repulsive instincts and habits manifest themselves better sometimes to the common acquaintanceships of years. Temper is tested in many forms of hazing, fagging, etc., to see if the victim will retaliate, how much

provocation is necessary to bring him to that point and what form the reaction takes. If peculiarities of body, dress or manner are salient, these are likely to be sore chologenetic points of attack. Girls who blush easily or are so ticklish that even a pointed finger sets them off, have red hair or even deformities, are particularly tempting to constitutional teasers, who are usually, though not always, cooler and better tempered than their victims. These experiences are really very often educative and develop control in the victim, although sometimes exactly the reverse is true, and tempers may be thus spoiled. Teasers with a strong propensity for practical jokes, playing April fools, etc., who are usually older and stronger, often profess and sometimes really have the purpose of teaching control. When anger is once roused, the goal with some is attained. More commonly, ridicule is then applied which intensifies the rage, and other methods of fanning it to its utmost often give the keenest enjoyment to the provoker. This peculiar pleasure in witnessing manifestations of anger is partly due to a sense of superiority of poise, and no doubt partly to pleasure in witnessing primitive psychological forms of expression, while the factor of cruelty and sport with a victim in one's power is probably the strongest motive of all. The tormentor chuckles, his eyes sparkle with delight, he claps his hands, dances, jumps up and down, rubs his hands, slaps his leg, points his finger, taunts, jeers, yells, calls it fun, and all this tends to egg on the victim to extremes, the memory of which is well calculated to cause regret, mortification, and the resolve for better control next time.¹

With the cry point, no less variable than the anger point, the case is very different. The tormentor often stops short at this point, and sometimes the mood reverts to pity, sympathy, and regret. This is especially the case if the cry is one of collapse, surrender or real grief, with no impotent anger in it; but the aggravation may be pushed still further with accusations of babyishness in quest of a deeper lying and later reaction, and particularly a boy that has no fight in him is despised.

II. PHYSICAL MANIFESTATIONS OF ANGER.

Upon this topic our returns are fullest and have been carefully tabulated and compiled with the following general results:

Vaso-motor Disturbances. Eighty-seven per cent. of the best cases describe flushing, and twenty-seven per cent. describe pallor as one characteristic of anger. The heart is often immediately affected and sometimes with very painful cardiac sensations.

¹ See Burk: Teasing and Bullying. *Pedagogical Seminary*, Vol. IV, p. 336.

It pounds and bounds, there is a feeling of compression, and the literature elsewhere referred to describes several cases of death from cardiac lesion thus caused. Occasionally some pulsation is felt sometimes painfully in a particular part of the body. In one case in the palm of the hand, another specifies the wrist. In many cases severe headaches with rhythmic intensifications for each pulsation are caused by the general disturbance of vascular tonicity. One woman describes the enlargement and pulsation of the temporal artery as the sign by which she best recognizes temper in her husband and describes a peculiar whirling sensation in the head. Stigmatization over a large V shaped area in the forehead occurs in one case, the face may become mottled, certain local pains sometimes sharp, which attend anger, seem thus best explained as does the dizziness and faintness often mentioned. The nose grows red or blue in one case, the eye balls are blood shot, and erethism of the breasts or sexual parts may occur. In one case the first sign of anger is nose bleed, and if it is copious the anger fit is less violent. Menstruation may be arrested, sometimes suddenly, and other psychic weather signs indicate a more or less intensive vaso-motor storm.

Secretions. The glands are no doubt far more closely connected with psyche than has hitherto been supposed, and we shall have no doubt ere long a glandular psychology. Of course the most common secretion is that of tears, which are specified in about 35 per cent. of the returns. Tears may be shed when other symptoms of crying are repressed. Salivation is not only more copious, although in later stages of a long rage it may be repressed till the mouth is described as "bricky dry," but perhaps its quality may be modified from the stomach or otherwise, since in some cases a bad taste is characteristic of anger. Its effect upon mammary secretions in nursing women is very marked, sometimes by way of almost total and sudden suppression, often by some modification of the quality of the milk, so that the infant is made ill. Urinal secretion is often affected rarely by way of suppression, but is commonly more copious, paler and with less deposits. Popularly anger is thought to be closely associated with the liver, and a bilious temperament is supposed to be peculiarly irascible. In not less than a score of cases, attacks called bilious are ascribed as the direct effect of anger. No less frequent results are constipation and diarrhoea, which may at least belong in part here. There is no case in our returns that suggests any modification of the action of sebaceous glands, but in two cases a rash, once said to be all over the body, follows every fit of anger in a child; and in the case of one male sexual secretion attends every violent outbreak. It would be very interesting to know how common this

is, and a collection of facts here might throw valuable light upon Sadism and Marrochism. Sweating may be copious in cases where increased muscular action fails to account for it. Whatever may be true of other emotions, some of which we know to be closely associated with glandular action, there can be no doubt of the relation here.

Salivation, Swallowing and Nausea. The act of swallowing somewhat like that of winking is normally repeated at brief but varying intervals through the waking hours. Just how much is due to the summated stimulus of accumulating saliva and how much to the constantly increasing lability of the nervous center involved it is impossible to determine. Of these two factors, however, there is abundant reason to believe that each is independently variable. Many returns specify swallowing, often several times in succession, as one concomitant of the early stage of anger. Occasionally the impulse to swallow is strong but is inhibited, and gagging, lump in the throat, and temporary paralysis are described. This beginning of the peristaltic action that forces food through the many feet of the alimentary tract is, of course, far more under control than the latter stages. The will delivers the bolus of food to the back of the mouth, whence it is taken in charge and propelled by the more reflex mechanism. In carnivora the attack and slaughter of prey is the normal prelude to eating it, and like salivation this movement may be a residuum of an ancient association without assuming any earlier canibalistic stage. The question is how far the momentum of this paleo-psychic association enters into the psychoses of anger, which has as its tap root the quite different impulse of defense and resistance. That it enters, I think there can be no doubt.

Nausea with anti-peristaltic symptoms more commonly occurs near the end or in the reactionary stage of an anger fit, and sometimes acts as the chief inhibitory motive to the impulse to swallow. Its cause here seems to be mainly the fatigue from over excitement or exertion, any form of which may cause it. There seems reason for raising the query, whether these two contradictory functions are so related that if the first is overdone without sufficient stimulus, incipient nausea arises in a compensatory way. If one swallows as frequently and as long as possible without eating and when in the normal state, incipient nausea arises. Swallowing is the act of appropriating the material on which life is made, and nausea means the repulsion or even the regurgitation of it, so that its symbolic significance is great and has been well exploited in both language and in æsthetics.

Spitting. In common with other secretions, salivation is often increased in anger, sometimes as would appear with, and

sometimes without, chewing or biting movements. In some of our cases the saliva is copious and runs from the mouth upon the clothes in a profuse and offensive way, and in three cases it is described as frothing at the mouth, and in one as white froth. In the acme of the stress and strain of fighting, this is puffed or blown, sometimes it would appear purposively and at other times unconsciously, upon the clothes or in the face of the opponent. Just what all this phenomena involves is difficult to determine, but it would appear that at least in some cases the drooling in anger is partly due to temporary and partial paralysis of the lips and perhaps of deglutition. Local exhaustion may be carried so far that it would be no more possible to spit than to whistle. To associate the salivation of anger with primitive anticipation of savory food in such cases may seem a long cry, and yet it is not theoretically impossible. In creatures that kill their prey, especially if it is large and involves an erethism like anger, this association may have been established by very long and inveterate experience. Spitting proper begins consciously with what might be described as a t-p movement by slightly protruding the tongue, drawing it in rapidly between the lips and projecting its load of saliva by a slight explosion of air compressed in the mouth after the tongue has been withdrawn and before the lips have closed. Children in the second and third year learn and sometimes practice this. This movement has apparently little utility for the child and is essentially a sign of aggression. It requires much delicacy and co-ordination of labio-lingual movements, and would probably be impossible in a creature less highly endowed with articulatory capacity. It is therefore of special interest. Another mode of spitting, which appears to be later, is what might be called the p-t movement, in a sense the reverse of the preceding. It consists in thrusting out the saliva with the tongue with much breath pressure after the manner common among tobacco chewers. This movement is more difficult and is often practiced with unpleasant results. From the age of four or five years on to near puberty, spitting may be a prominent expression of anger. At first it commonly seems directed toward the face, then towards the shoes, clothes, hands, seat, etc. Contests are described among expert spitters, both as to greater distance and greater accuracy. The victor in a fight sometimes spits in the eyes, hair, mouth, etc., of his prostrate enemy. The folk-lore upon this subject is very voluminous and pertains to the number of times one spits ceremonially upon given occasions, the place, direction, etc. It is, of course, one of the most extreme expressions of contempt and excites correspondingly intense repugnance. Saliva, of course, is a very effective medium of contagion, but the extreme abhor-

rence of the act when contrasted with the attractiveness of kissing, which often involves exchange of saliva and may be contagious, is hard to explain. Of course we have no adequate evidence of sufficiently venomous ancestors of man to sustain an argument that this horror is a toned down fear of virus-bearing sputa. The most that can be said is that there is no positive disproof of it and that the possibility is open. That even the bite of normal man or his progenitors is poisonous to another member of his own species, is unknown. The other possibility is that this abhorrence has some of its roots in long accumulated experience of contagion of morbid germs through saliva without dermal rupture, and that we have here an instinctive prophylaxis against contagion, which has given the folk-lore its character and form.

Respiration. Modifications of breathing are among the marked accompaniments of anger. Sometimes deep inhalation, often through the nose with clenched lips, perhaps several times repeated, as the need of increased oxidization deepens; sometimes rapid breathing, which may be through the mouth, and give the effect of panting and occasionally almost gasping, is described. Stutterousness, almost suggesting a snort, purring, snoring, choking, gagging, and sobbing noises that almost suggest hysterical globus—all these cannot adequately be accounted for by increased muscular activity. Whether the type of respiration changes from abdominal to pectoral or conversely, and what the form of the respiratory curves through a fit of repressed anger are, it would be interesting to investigate. Amphibian life requires periods of deep and rapid breathing, alternating with longer periods of rest, and it is not impossible that the preparatory stage of anger symptoms is analogous in some cases to preparation for a long dive with violent exercise.

Noises. In twenty-eight young children screaming is more or less fully described as the most characteristic expression of anger. Crying is a language all its own, and as it develops in the first year or two of life the mother or nurse readily distinguishes the cry of hunger, fatigue, wetness, pain, etc., but none is more characteristic than that of anger, which is loud, sharp and generally sustained. A little older children develop sometimes very characteristic snarls, growls, grumbles, whoops, bellows, chatters, bleats, grunts, barks, or noises that sometimes consciously, or more characteristically unconsciously, suggest the cries of animals. Later, occasionally, specific words of warning, threat, defiance, or specific oaths become habitual and characteristic of rising temper. In some children anger brings on a fit of stuttering or a peculiar tremor or staccato, or speech may be interrupted by a noise suggesting a

sob. In older people the voice is perhaps the most sensitive of all the registers of anger. It is loud, shrill or harsh, with variously modified rhythms. Later yet control and repression may develop a peculiarly slow, calm, low, precise utterance which is with difficulty, and not without considerable acquaintance, recognized as a danger signal. One woman almost whispers, with little phonation, but very intense labio-lingual expression, and unwonted relations of these two elements of speech are common. Many become exceedingly voluble, irrepressible and almost eloquent, while some are glum and monosyllabic. Not infrequent is the habit of soliloquy, and many seek solitude in order to find, perhaps in monologue and perhaps in other forms of loud vocalization, the readiest vent for passion. One woman is conscious of no modification of voice in anger except a slight tendency to be hoarse afterward, even when she has not spoken. Perhaps a dozen well-described cases cannot speak or make a noise, but are vocally paralyzed or they cannot speak without crying. Theories of the origin of language like those of Noire postulate a very close connection between the intense muscular tension and loud phonation. The characteristic cry of epilepsy shows the same, as does the battle cries of various savage races. College yells at athletic contests are toned-down cries of defiance.

The close association between anger and noise is seen in many ways. Some stamp, walk with heavy or with shuffling steps, must pound something with a stick or with the fist, or beat a loud tattoo with the fingers or feet. One young woman goes by herself and slams a particular door; a girl pounds the gutter with a stone; a boy throws stones against the loose boards of the barn or against the resonant surface of a large sugar pan. Several work off their anger by playing or even pounding the piano. The gratification in these cases appears to be not solely from making, but also from hearing a loud noise.

Involuntary Movements. Of these there is a long list, many of which fall under other captions. Changes of muscle tonus are seen in the changes of the voice elsewhere noted, and in the relaxation or, less often, the tonic contraction of the sphincters, which causes escape or retention of the excreta. Horripilation is sometimes described, the skin becomes rough, and shuddery, creepy, crawly sensations occur. In one case twitching of the skin on the right leg, in one upon the shoulder, and often tonic or clonic or choreic movements of the face and fingers are described. The relation of voluntary to the involuntary activities, which is always a variable one, suffers in anger, and the disturbance and the readjustment is best seen in weak persons with strong temper after it is over, in which

arterial and cardiac tension, respiratory rhythms, etc., are modified.

Attitudes and Postures. In anger the body often becomes more or less stiff and rigid, is drawn up to its full height, sometimes with an attitude of pride that suggests strutting, the legs are placed apart when standing, and all the antagonistic muscles are tensed up, so that there is a great expenditure of energy, sometimes with very little activity, along with which goes a feeling of great strength, a difficulty of making correct or quick movements which may otherwise be normal, and which reacts sometimes into the stage of collapse later. Some habitually assume a characteristic attitude when angry, usually erect. Two seek to place the back against a wall, post, or other firm background. Two are impelled to sit and eighteen to lie down, mostly upon the face, and perhaps to roll, writhe, squirm or wriggle. One must throw herself into a chair sideways, in a particular manner, with feet drawn up. The arms are more commonly held down by the sides with slight pronation or supination movements, with fists clenched; sometimes one or both hands are placed against the breast. One young man always thrusts one hand into his coat and the other into his pocket, and probably a large number of more or less characteristic positions could be collected.

Butting and Pounding the Head. Many infants when angry and powerless to hurt others, strike their heads against doors, posts, walls of houses, and sometimes on the floor. In this gesture the head may be struck so sharply as to cause pain and crying, but more often it is pounded several times with a violence which would in a normal condition cause weeping but does not now. In some children bruises and discoloration lasting for days results. Occasionally in older children headaches seem to be thus caused. This expression of anger rarely outlasts early childhood, but sometimes persists into adult years, as in one striking case elsewhere in our returns of a young man who habitually pounded his head on the floor when his best girl danced with another. Sometimes the head is struck violently with the fist and quite often, not only in infancy but in boyish fights, butting is a mode of aggression. Some boys love to butt and attain great ability. One is described as running a rod at full tilt and injuring a companion dangerously in the stomach. Another boy practiced butting hard objects to attain virtuosity. Blows with the head are often described as sideways; the forehead or particularly the corner of the forehead, being the point of contact. This is interesting when we reflect on the number of horned species in the human pedigree. Why should man hook like a cow or butt like a sheep or hammer with his head, and that, too, when the skull is thin and elastic,

and the brain so delicate an organ? Surely there is nothing in the present human environment to adequately explain why such an experience, which undoubtedly causes more or less of a shock, can give satisfaction or relief in anger save on the general theory that it demands augmented motor and sensory experiences. Early vertebrates, both aquatic and terrestrial move head first, and there is thus a long ancestral experience of removing obstacles and breaking way through the water with the head. That there is some relation between these manifestations of anger and previous phyletic experience, I think can at least not be denied. In children incipient anger often manifests itself by the threatening sideway nod which very clearly suggests danger and seems to be the residuum of an older mode of going at things. In anger the head is often thrown down and the eyes partly closed as if in preparation, and square nodding in front, especially if repeated and with accompanying pressure of the lips, is a threat. When the fore extremities were engaged in locomotion or otherwise, the head played a more important role in aggression than in bipeds. Often in children we have the opposite anger gesture, instead of going at things head first the head is thrown back out of reach and out of the way of attack. Several boys, however, in our returns seem to be proud proficient in having skulls unusually thick with which they hammer the heads of their more tender opponents, until they cry for mercy; whereas others particularly dread combats lest this part of the organism should be injured.

An occasional expression of anger is stamping upon the toes or feet of the opponent or upon other parts of his body, when he is down. This is sometimes done with the heel and with great cruelty and deliberation. One boy injured for life two fingers of his adversary in this way. Stamping perhaps really begins in the foot movements of infants before they can walk, who angrily kick out with the sole of the foot against persons, the wall or any other object. In older children to stamp the ground or floor is an admonition always to be heeded, for it is a menace of starting to go at the adversary. In many savage dances stamping the ground, sometimes with bare feet and with great force, is an expression of annihilating an imaginary foe. Sheep, some birds, and other animals do the same. In only one case does the child make a movement described as pawing to get at an antagonist; but the writer remembers a case in his boyhood where this was carried to a marked extent, although probably in imitation of bulls. Stamping suggests having the enemy under foot and thus complete triumph. A vigorous up and down movement can tread out life very effectively. Our returns show that soon after learning to walk,

children vent anger thus first with no reference to an adversary, but later looking or pointing to him and thus launching a threat, where often an attack would not be ventured. The first seems quite automatic and unconscious, possibly the noise itself may have been one factor. When there is no alternation but with one foot and repeated, the gesture surely has some unique significance.

Making Faces. Violent anger often distorts the features, both by engorgement of blood and changing muscle tension. Often this is described in the returns as bringing out strange, perhaps repulsive and even animal traits and resemblances, and it may extend to nearly every part and feature of the face, modifying its natural hue, bring out veins and wrinkles, and occasionally unilateral modifications. Not infrequently the subject is painfully conscious of looking unusual and of having strange facial sensations, and this and the instinctive corrective impulse often aggravate the difficulty. Although there is very great individual difference in this respect, the face sometimes betrays sentiments almost as delicately as the voice. Many facial movements, too, are unconscious. In early childhood the very common vent of anger is consciously making faces. Our returns do not permit reliable statistical inferences concerning the frequency of the different types of contortion. Opening the mouth and protruding and often moving the tongue, especially out and in, turning the end of it up to show the under side, running it down toward the chin, flattening it, wagging it sideways—are specified and suggest contempt and perhaps insult. Drawing back the upper and the under lip to show the teeth, especially pouting or protruding the lips, stretching the mouth laterally as far as possible, drawing down its corners, projecting the under lip and more rarely the upper one, twisting the jaw sideways, projecting the lower one, drawing in one or both lips, opening and shutting the mouth, sometimes in a gnashing way, a special kind of nasal sneer, and other movements hard to describe that suggest very repulsive smells, tastes, perhaps to the point of nausea, and movements that suggest the threat of biting, occur. The upper part of the face, is on the whole, less involved, and vast as the individual differences are in facial mobility, they are greatest of all for the forehead. Some have little power to raise the eyebrows or produce longitudinal wrinkles above them, and perhaps still less power to frown with vertical wrinkles, and fewer yet can produce both at once. There is less unilateral power of movement in the upper part of the face. The eyes may be open very wide, emphatic and frequent winking makes them flash and sometimes they are nearly or quite closed, but more often rolled up, down or sideways, to show the white. Some

children become almost virtuosos in making faces and this propensity seems to culminate shortly before the dawn of adolescence. The number of combinations of all the possible movements here is vast, and one cannot look over the literature upon the subject without being impressed with the fact that Darwin, Duchanne and the Delsarteans have as yet barely entered this interesting field. Head positions and movements are another factor which serves to bring out the effect, and children often use the fingers to intensify eye and mouth distortion, while gestures and noises aid to set them in relief. Interest in facial expression is deep and instinctive. All children study the face and especially the eye as an index of feeling and disposition, and the variously toned fear and pleasure in them suggest the strange passion of savages for masks as seen in their dances, many of which even introduce marked animal features. Pleasant expressions of the face are habitual for happy moods and for friends, and the principle seems to be that the degree of departure from one's best expression indicates the degree of dislike. Many facial expressions are no doubt directly intended to strike terror, but others are suggestive of various degrees of repulsion. Reverence and respect have their own characteristic physiognomy, while contempt even parodies or else seeks the contrary of it by the law of opposition. Very deep seated is the instinct of fear at very unusual expressions of face in those we know.

Biting. Sixty-eight females, forty-eight males. From our returns it would appear that this anger act culminates a few years before puberty and has perhaps a slight and brief increment at its dawn. Very young children, soon after the appearance of the first teeth which are small and sharp, not only try them on all sorts of things but in anger can make a painful impression upon fingers, nipples, skin, etc. Some children run up to an enemy, inflict a quick hard bite, and retreat with no other aggressive act. Others bite firmly and hold on with tenacity, and fewer in our returns chew what is bitten in anger. In their fights, biting often plays an important role with children. In a few cases children bite their doll, the foot or tail of dog or cat, sometimes the place to take hold is chosen with deliberation, and the grip is so firm that it is with difficulty that it is released. We have records of idiots that seek to tear flesh in their rage. In many a brawl in the lower classes, noses, lips, ears are chewed, and occasionally bitten off and other damage is inflicted elsewhere with the teeth. I once saw a man in a cheap show who earned his living by killing rats with his teeth in a small pen, with no aid from his arms. He seized and shook them near the back of the neck and was rarely bitten himself. In the sex aberration of masochism, biting

sometimes plays an important and even a dangerous role in the organism. The biting of anger shades off into gripping and grinding the teeth, which is so long a manifestation of it even in adults, connected with the act of retracting the lips to show them. Sometimes one method of control of anger is to bite the tongue or lips till they bleed, or to grate the teeth. A Baltimore murderer, under sentence of death, once told me that if he had had a little stick of wood, which he always carried in his vest pocket to bite when he was angry, he would not have inflicted the fatal blow for which he was to die. Of course the jaws in man are degenerating from the size and strength they had in his prognathic ancestors and in his rodent or carnivorous relatives in the ancestral line, but just as his type of dentition is composite, so this function seems made up of factors from both ruminants and carnivora now almost inextricably mixed. A large, strong jaw still suggests firmness and a small one weakness of character, and in children as in adults, there are the greatest individual differences here. Some seem made to perform the gymnastic feats of sustaining their whole weight, lifting or swinging heavy objects by the teeth alone. Both the first and second teeth often pull unusually hard and we may have here the basis for a position in what may be called dental psychosis. A distinction is repeatedly noticed in our returns between the square, even biting of young children and the more dangerous side grip, which is preferred when the eye teeth appear. Our returns do not suggest whether the biting of anger shows an increment at this stage of development.

Two things seem certain. First, that even modern civilized man has more or less adjustment between dental structure and function, the latter being proportionately less than the former. The passion of children for biting sticks, chalk, rubber, pencils, slates, chewing gum, etc., suggests that the biting of anger may be intensified by the fact that this function is declining and is both vented and mitigated by such activities. If man ever approximates an edentate stage with less mandibular power it will no doubt coincide with modification in this respect. The other suggestion which I venture is while the sneer, the *spasmus cynnicus* of pathology, may no doubt be gestures which are relics of dental attack, the kiss seems to have a very significant and opposite function. Its meaning seems to be that where danger once was greatest, when we reflect that the maws of their enemies have been the grave of most species, that now not only a truce but complete trust, and even pleasure, reign. One feeble-minded child is described as making the gesture to kiss, but when the lips were presented set his teeth firmly into and almost through them, and, in the

opinion of the reporter, actually sucking with pleasure the blood that flowed.

In adults the mouth often twitches, the lips are white, pressed or cold, and in the reaction the teeth often chatter. In 650 well-described cases, grating the teeth is mentioned in 27 per cent.; showing them in 21, quivering lip in 18, compressed in 11, pouting in 9. Some describe a peculiar "mouth-consciousness," others chew the tongue or inner wall of the cheek, swallow, choke, cannot speak, etc. Such expressions as "Would like to devour," "feel like eating, tearing, rending, crushing," occur with dental experience. Whether these are the last vaso-motor or involuntary automatic residues of what was once a fully unfolded carnivorous psychoses we can only conjecture. M. D. Conway, in his demonology, describes the devils or ex-gods of most primitive peoples as having for their chief characteristic capacious maws and dreadful mouths, with great, sharp and cruel fangs. The marks of many dances and ceremonies of the North American aborigines¹ are thus distinguished, and the instinctive fear of big teeth, so characteristic of infants is a psychic indorsement of the same fact.

Scratching. This is mentioned in 142 cases as a characteristic expression of anger, and is described more or less fully as habitual in the cases of thirty-eight males and eighteen females. The age at which it is most common is from two to nine years; and at fourteen, judging from our meager data, it entirely stops in males and is greatly reduced in females. While boys predominate in early childhood, the proportion is apparently reversed in adolescents and adults, women with their conservative organism then predominating. Instead of being clenched, the fingers are hooked rigidly and the movement is from the elbow and more from the shoulder, and from up downward. The point of attack is generally the face, more often the eye, although neck, hands, arms, and even the clothes are often scratched. In several cases anger at dolls, animals, inanimate objects and even self are expressed by scratching. One child lacerates her own face when angry. Two scratch the paint off doors and articles of furniture against which their rage is excited. Several have inflicted serious laceration upon younger children and infants, but in most cases the favorite point of attack seems to center about the eye itself, into which it sometimes seems a strong childish instinct to stick a finger. Our data give no indications that there is here any trace of an old instinct to attack the throat or any covered parts of the body. Occasionally in anger the hands are so tightly clenched

¹ In My Study of Fears. *Amer. Jour. of Psychology*, Vol. VIII, note, p. 312.

that, either with design or incidentally, the nails are forced into the palms. It would almost seem that some children have a love of scratching the skin as a motor activity independently of the sensation of stimulus or relief of itching along the afferent tracts. In the felidæ and in other animals, both in and near the conjectured line of human evolution where claws are best developed in structure and function, these movements seem among the first group to be acquired, especially by the forelegs after and superposed upon their locomotor functions. These movements are more specialized and accessory than walking, and among the climbers have a great but very different role. This may be set down as one of the first uses, then, not merely of the digits, especially of the pentadactyl hand, and this psychic co-ordination with dental function is close. The infant's finger nail is much sharper than the adults, is more curved, and hence has more sustained rigidity, while the skin of infants is thinner and more tender. Hence the greater effectiveness of this mode of attack. Very interesting are the few cases in which scratching is not mentioned, but in which one of the marked signs of anger which our correspondents describe in themselves is the purpling of the flesh under the finger nails. Interesting, too, are four cases where in anger a shudder which suggests scratching a file, rusty saw, or some other object, is provocative of incipient horripilation or some nervous spasm. This function is so co-ordinated with structure that careful and regular cutting of the nails may reduce it, as does the enforced wearing of gloves or artificial tips where the habit is abnormally strong. Some people shudder whenever they hear a noise that suggests scratching hard objects or the earth, and the very thought of scratching a brick or stone causes "sinking" symptoms of a very marked nature in F. 18. Long after this habit has passed away, many people describe as a symptom of anger the feeling that they would like to tear the flesh of the offending person. Again, some children cultivate long nails, less for use than for ornamentation, as several Oriental religious sects make it a sin to cut the nails, even if they penetrate the hand. Nails have sometimes an important industrial use in occupations requiring fineness and exactness. A few barefoot boys are described as scratching the antagonist with their feet. Civilization has so long required trimmed and shortened nails that it is possible that this has had an effect upon their reduction. The habit of biting the nails to the quick has very likely a kindred psychic origin with the impulse to trim them. Very curious is the survival in some of our cases, particularly females, of habitually trimming the nails to a point more or less sharp or obtuse. How many modern industries that involve scratching, like

movements such as writing, have any relation with any such ancient function, it is impossible to tell.

Pinching and Pulling. This culminates relatively late in childhood and continues at least to maturity, and probably through life. The strength of the opposing thumb must become well developed before it can be effective. Small children pinch the skin, often without bringing the nails to bear; the ear and nose are thus attacked and pulled. The arm is often thus made black and blue; the back of the neck is seized and pinched till the victim obeys the command to say "Shakespeare" or some other words, or to do some ordered and unusually humiliating act. Strangulation is sometimes thus attempted and the sexual organs may be thus assailed. Along with this action often goes pulling and shaking, indeed infants often pull hair and beard before they learn to oppose the thumb, and the difficulty of disentangling these from the baby's grip suggests arboreal life, in which the young thus hold to the shaggy sides of their parents as they moved among the tree tops, an act which natural selection has developed by eliminating those that let go and fall. While the child rarely shakes an object grasped with its teeth, objects clenched with the hands are often shaken. Both ears are grasped and the head violently pulled, twisted and shaken. One or both arms are thus used as handles by which to shake the body, so that the pain may be either in the pinch, in the pull, or in the shake. Where nails are used, the flesh may be dented, bruised or occasionally cut, and two instances are cited where poisoning is believed to have been thus conveyed by bacteria under the finger nails. The ears are sometimes permanently mutilated or distorted in this way, and far more serious is the injury, and once the death, reported from "Abelarding." In some conflicts handfuls of flesh from the breasts or any other part of the body are clutched and grave internal injury done. In one case, hair is said to have been pulled out by the roots and the scalp torn. In two descriptions of a fight, the tongue was thus attacked. In one case, the mouth was forced open for this purpose, and Mantegazza tells us that it has been thus torn out and the lips and the alae of the nose torn. In some forms of fighting the antagonists seek to pinch the fingers of their opponents, and particularly to twist and double them up to the point of dislocation. Sometimes any part of the body is grasped for a hold as one would grasp the clothes or through them. The variety of tortures possible in this way is great, and all must have been developed since the hand acquired its biped strength and dexterity. Not only folklore, but popular tradition, describes hand power developed to such an extent that by a single favorable grip an enemy has been disemboweled.

Kicking. This we distinguish from stamping as a lateral movement at right angles to it. It begins later, is far more common, and lasts through life. In most children the movement is front, but in some the stroke is backwards with the heel when it is more downward. The front stroke must discriminate very carefully if the foot is unarmed with a shoe where the blow is applied, for if it were a hard place in the antagonist's body the agent suffers more than the patient. Hence, the abdomen or the posteriors are common points of attack, the latter particularly permits the infliction of greater force and the blow has less danger. With shoes or boots any part of the body can be attacked, and the injury and danger is far greater. Some oriental forms of wrestling might be described as almost solely made up of tripping and kicking, where the arms and hands have nothing to do. I once saw two boys fight solely by trying to scratch with the feet. Heavy foot gear makes this expression of anger almost approximate in prominence that which it holds among some of the ungulata. One object is here often to overthrow the adversary and is peculiar perhaps to bipeds, who have assumed the erect position and for whom balancing upon a few square inches of foot surface with the center of gravity so high above, is quite a feat of equilibrium, and makes a fall often dangerous and an upright position always a little precarious. The usual strong forward kick as, *e. g.*, in football, and which is susceptible of a good deal of culture, is a mode of aggression which must have been originated however distinctly after the erect position had given the posterior limbs their strength and weight. It, like many other primitive modes of anger, has an extremely rich symbolic and metaphorical philology.

Hugging, Striking and Throwing. Young children often vent anger by hugging, and it is especially common among girls. The offending person or even animal is thus punished. As an aggressive method, this movement may become very effective and makes for strangling, the compression of crushing, and bones, joints and tendons may suffer thus.

Anger, however, is essentially repulsive and the gesture of pushing away is more common. From the latter, it would seem from such data as are at hand, striking evolved. The first blow in infants is a literally repulsive or standing off gesture. Although animals kick, butt, and strike with paws, etc., man might almost be called in a peculiar sense, the striking animal. His blows, although at first, perhaps, scratching movements, and at any rate more likely to be from above downward, change later into slaps, and last of all comes the straight out blow with the fist. This can, as pugilism shows, be made exceedingly effective with the unarmed hand. The skill and

dexterity in choosing the place and time of a blow, throwing the whole momentum of the body into it, to say nothing of foreseeing and warding off the blows of the adversary, make the development of this very human mode of attack susceptible of great perfection, and constitute the charm of slugging and mauling contests according to fixed rules, which eliminate forms of onslaught phyletically lower.

With the use of weapons began a new era. Even a stone or stick gives greatly increased efficiency and adds to the danger. Clubs, axes, spears, and a great variety of savage implements of warfare enhance many fold the dangers of conflicts and have prompted the invention of shields and other defensive and protective implements. It would seem from our knowledge of apes to be well established that they can use clubs and stones at least for certain purposes, but it is doubtful if these have ever been a factor in their combats.

Throwing introduces yet another development from the striking out blow. A missile is propelled far beyond the reach of the body, and bows, guns, etc., have made this the most effective, as it is the last, mode of offensive warfare.

We have space for but a few cases.

1. M. Fits of anger are plain in a child 7 months. She holds her breath a moment, seems expectant, grows red in the forehead and cheeks, straightens out stiff and rigid, trembles, chokes, and laughs merrily.

2. M., 8 months. Throws himself on his back, lies rigid and still, but yells at the top of his voice.

3. M., 15 months. Strikes himself savagely in the face, pounds his head but never any one else, spits at us and cries "Go way."

4. M., 2. Was set down hard on a chair for disobeying. He grew pale, then red, sweat profusely, made mouths as though trying to talk, but his teeth chattered. I only saw this once and am sure it has not occurred within the past fifteen months.

5. F., 26. A boy of 3 began to bite when in a temper. He always bites and kicks, throws anything and flushes.

6. F., 21. A 3 year old girl of violent temper, once punished by being kept home from a ride, broke out in sobs that appeared uncontrollable. Suddenly she stopped short and calmly asked if papa was in. Being told no, and realizing that there was no possible restraint from that quarter, she resumed her sobs.

7. Eng., F., 41. I know a boy of from 3 to 5 who had marked relaxation of all the sphincter muscles when angry.

8. F., 41. A delicate boy from 3 to 5, when angry, flushes all over his face, neck and ears. Anger so completely absorbs him that once he was undressed during a mad spell and did not know it.

9. F., 4. Prayed one night for the hired men. The next day one of them, a disagreeable tobacco user, kissed her; that night she prayed unctiously, "God bless papa, mamma, etc., but dear God, damn Mr.—."

10. M., 4. In a tempest of sudden anger strikes any one in the face with all his might. This he used to do when he was a year old, but in a moment he wanted to kiss.

11. Papa told M. to sit down. It was his evening play hour. He

drew himself up, looked his father full in the face and said "you dasshopper" three times, and then obeyed.

12. M., 4. In a passion has a blind rage, has thrown forks and knives at people, broken dinner plates and glass, etc.

13. F., 5. Is usually bubbling over with fun, but when crossed, rules the household, which has a terror of her tantrums. She screams, rolls on the floor, sticks out her tongue, turns up her nose, and takes it out in making up all manner of horrid faces.

14. Eng., F., 28. Children I have observed stand perfectly still, open the mouth wide, and begin to scream. Later they dance wildly, brandish the arms and hit anybody. Others lie on the floor and roll, pound their heads, roar, sit and rock; others bite and scratch; tears are a sign that the repentant mood has begun to react.

15. F., 19. Some children I have seen turn white or red, howl, strike blindly. Boys control their feelings far less. A little boy lay in the mud and screamed because I would not buy him candy. I had to pick him up and carry him home yelling.

16. F., 41. A little girl in a pet first seems pleased with herself and looks to her companions for admiration. She shakes herself, settles into stolid sulks, which sometimes last two days, then cries, re-lents, and is extra good.

17. Two little boys were set down to write, but there was only one pencil, which was given to the elder. The younger flushed, flashed, and said "Do you fink I can write wid my finger like God?"

18. F., 31. A little girl constitutionally obstinate, when in a temper would grow red as a turkey cock about face and neck, which would seem to swell with anger. Her eyes filled with tears, but she never cried. She readily asked forgiveness and never bore ill will. When people are slow, she wriggles, writhes, bites her lips, snatches your work, and wants to do it herself.

19. A girl of 6, who has ambition as her ruling passion, is most enraged by her jealousy. If she is excelled in writing, she will try to sponge out the work of others, and to scratch them, lie down in the grass and kick and cry, because she cannot jump as high as her mates.

20. M., 28. My temper was so dreadful that I did not mind what it cost, it must have way. As a child I would scream, kick, rush at things and throw objects in the fire or out of doors, if my plans were frustrated. To put me to bed disturbed the whole house, so that my nurse usually gave way to me. Every point I scored made me worse, I was often wild and utterly unreasonable.

21. F., 19. A sweet little girl of 6 I know has outbreaks of passion, that seem to pass beyond control, when she stands and howls quite unconscious of everything. When it is all over she often cannot recall the cause of her temper. The only thing that helped her was diversion or some soothing action, like stroking her hand. When it is all over she seems to have forgotten both it and the cause.

22. F., 28. When I am inwardly impelled to say unpleasant things to people, I tremble, am short of breath, my teeth chatter, and often have a pain in my stomach, which causes sudden diarrhœa.

23. M., 28. When angry for sometime I twitch painfully in the palm of my left hand and also in the veins of my left wrist. In both these instances the pain is very much like the shock from a strong battery. It seems as if the blood was trying to get out of the small vessels causing them to stretch and snap back with violence.

24. Eng., F., 27. I know a child who has fearful fits of temper, after which a rash breaks out all over her body. Once she rushed into a tub of cold water with all her clothes on.

25. F., 19. When angry with the cat I used to squeeze it tight,

pull its tail, stroke it the wrong way, put my finger in its eye, and through childhood my anger generally vented itself by hugging.

26. F., 22. I literally boil. The angrier I am, the more compressed and internal it gets and the more silent I become. If I speak, I cry. My intellect is confused or rather does not move under the pressure put upon it. If I thoroughly start crying, the fit wears itself out, but if the cause requires action, I can stop crying. The effort to deliberate sets my mind flying.

27. F., 23. When I am angry I feel as if a demon was inside me tearing me to pieces, and if it must come out before I can be happy. Commonly it is vented in vicious little speeches, and deeds, aimed not particularly at the object which caused it, but at every one and everything. I take a sort of pleasing misery in contemplating the pain I inflict.

28. F., 29. Some children are white with rage, but more are crimson. They pinch, bite, scratch, and stiffen themselves. One little girl is so rigid that she can be picked up by her waistband, and held perfectly horizontal in the air. The sulky kind that hold temper is the worst.

29. M., 34. Symptoms of anger as I have seen them suggest the etymology of the word, which means compression of the neck, strangling, etc. This expresses my experience of it better than the words, spleen, vexation, ire, wrath, rage, resentment, malice, hate, indignation or any others.

30. I know people who change color, contort the face and even body. The hands clench, the muscles stiffen, the eyes flash and flame, the voice changes its pitch, time and quality. Some strut and other children dance, fall, butt, etc.

III. ANGER AT INANIMATE AND INSSENTIENT OBJECTS. VENTS.

Every one is familiar with the disposition to kick the stone against which one inadvertently stubbed a toe, to pound or even kick a door against which we have hit the head between our groping hands in the dark, and our returns abound in cases of pens angrily broken because they would not write, brushes and pencils thrown that did not work well, buttonholes and clothes torn, mirrors smashed, slates broken, paper crushed, toys destroyed, knives, shoes, books thrown or injured, etc. These violent reactions by which often the individual is himself injured, and in several cases seriously, occur not only in children but in adult and cultivated men and women. A man finding that the blossoms of a favorite and much nurtured pear tree were blasted for the third time, hacked it and barked it in a fit of rage, until it had to be cut down. A man of over forty fell over a roll of barbed wire at night, and the next day threw the whole into a bonfire and dumped it in a fish pond with much satisfaction. A farmer laying a stone wall found the stones so round and smooth, that they slipped down several times, and in a fit of anger, as he says, and not to split them into better shapes, he mauled them till he was tired with a sledge hammer. In one case described at length, a young car-

penter injured many times and even spoiled his own expensive tools, because he was so clumsy and inexperienced that they would not work right; and the destruction of one's own or others' property by this impulse is frequently recorded. A few cases are appended.

1. F., 20. When a door will not stay latched, my little brother of 6 bangs it very hard several times, sometimes kicks, strikes, and even butts it.

2. F., 19. Boy of 4 grew often angry with his blocks, kicked and threw them, saying every time "Take that and that."

3. M., 19. I once fell on a large stone and hurt myself badly and vowed I would smash that stone sometime. Some weeks passed before I got a stone hammer, broke it to pieces, and threw the fragments in a fire.

4. M., 25. If when cracking nuts or driving a nail, I hurt my finger, I am so mad I have to smash something instantly with the hammer. Once my boot, which had been wet over night, was so stiff in the morning I could not get it on. In rage I pounded it well with my hammer.

5. M., 9. Pinched his finger in the door. Cried a while, then stopped and kicked the door, hurt his foot, cried again, kicked it again less intensely, scolded it and dared it to hurt him again.

6. F., 20. My brother M., 5, became angry with his drum and broke it into pieces. He fell on his rubber skates aged 7 and broke them both.

7. F., 18. I have vented anger on nearly all my toys, and could not keep them long if they were destructible. When angry I often drum with my fingers, tap my feet or if alone pound and stamp around.

8. F., 16. If I cannot play my exercises right, I pound the keys. If my sums go wrong, I throw and sometimes break my slate. I have torn books, cloth that I could not cut right, and smashed wood and sometimes bang the tools in the manual training room.

9. M., 17. When I could not learn something in my lessons, I used to sling the book across the room. My toys have suffered a good deal.

10. A boy of 8 cut himself with a knife, threw it in rage against a stone, and finally broke it with another.

11. A boy of 4 hits every large object against which he hurts himself, and throws all smaller ones.

12. M., 28. As a boy if I spoiled what I was whittling, I would throw or smash it if I could.

13. M., 18. When I used to bump my head, I wished with all my soul that I could make the thing I hit suffer for it.

14. F., 19. When angry I used to kick rocking chairs. This made them rock and this made me more angry, because they seemed alive.

Such things are often done with a kind of lurking, nascent self pity, sometimes with a trace of self contempt, but more often with a bottom feeling of the humorous absurdity of it all. Where pain is caused, such reactions serve as a vent, but on the whole we seem to have here a momentary lapse back to a primitive animistic stage of psychic evolution in which the distinction between the things that have life and feeling and those that lack both was not established. At any rate our organism acts as if the offending brick, stubble or tool was capable

of feeling the effect of our resentment. This very strange group of phenomena can only be partially explained by urging that most causes of pain are animate objects, and that it is a second thought or long circuit reflection that does not have time to act, that this particular cause is lifeless; while the preponderance of the direct vent upon the object, as well as inspection in such cases, shows that it is not a case of stimulus and undirected reaction.

Vents. Besides the direct action upon the cause of the offence, very many indirect ways of working off anger are common, and this is often the beginning of control.

1. M., 24. Biting my lips until they ache and bleed is far more effective as a restraint for me than the puerile method of counting ten. Music helps me and if I can get at a piano, I can play off my rage. My aunt knits off her temper, and a cousin always plays Schumann's *Schlummerlied*, so that when we hear that we know she is angry, but will soon be pleasant. If a piano is not at hand, she suffers greatly.

2. F., Once I was so angry that I could not sleep until I got up, wrote the person a most violent letter, venting all my rage, and then tearing it up in the middle of the night. Then I went back to bed and slept sweetly. Girls, I think, are more angry, stay so longer, and do not forgive an injury as soon as boys. This is particularly true of girls from 12 to 15.

3. F., 24. I am reputed good tempered, but this is false, for I can fume and seethe within, when outwardly I am perfectly calm. I have a habit of giving inner vent to my anger by thinking cutting remarks; this relieves me, while the object of my indignation never suspects it.

4. F., 22. When my feelings are injured, I have now learned to be able to turn aside to something else. I cannot always do it, but this checks most outbreaks. I can often hold myself to my study.

5. M., 31. A cultivated lady of 25, wife of a well-known university professor, is sometimes so angry that she goes into the back shed and chops wood furiously, and says that something far worse would happen if she was denied this vent.

6. F., 23. When angry I used to pick up stones and throw them at something hard. The throwing relieved me some, but if they broke, the relief was much greater.

7. F., 9. Vents anger upon her hat and particularly her coat. Has sometimes broken things on the table in a pet, and in her tantrums is liable to seize almost anything anywhere.

8. F., 19. My youngest sister gets maddest if she cannot find things. She always pounds something. Her motto seems to be "Pound if not found."

9. F., 27. When I have been very angry I have just stood and pinched myself and bit my finger until I screamed. I used to want to tear something.

10. F., 16. When I am very angry or feel it coming on, I want to run to a particular place and pound the tin gutters for relief.

11. M., 10. Used always if possible to vent his anger upon stones; F., 7, on doors; M., 11, on bees.

12. F., 18. My anger is generally vented on my clothes. I go up stairs into my room and sling them around and sometimes dance on them.

13. American; Adult; Female. When violently angry would grind

her teeth, walk back and forth between two rooms so as to slam the door. Sometimes she would take a pillow and shake it until exhausted.

14. I always used to fly to the piano, or get my pet kitten to comfort me when I found my temper rising.

15. M., 26. I know a woman with a bad temper who when exasperated plays the piano or sings to herself, which latter is considered by her friends as a danger signal.

16. F., 28. When I was a girl and got angry, I used to shake my hair all over my face and make wry faces. It was very easy for me to speak out and tell very disagreeable truths. When trying hard not to talk, I play scales; and when very angry, octaves. To repress rage makes it far worse than to blurt it out.

17. I know a child who always relieves her ill temper by kicking a particular post. Her eyes are half shut and afterwards she shakes.

18. A nervous boy of 8 several times a day gets so angry he throws himself on the ground and screams as if he were being killed. He is growing thin and I think his temper will wear him out.

19. F., 27. For three years I had a pupil, nice in many ways, but addicted sometimes to say things quietly that nearly drove me mad. I always restrained myself, but once found that I had broken a new pencil that I had in my hand short off in my efforts to control.

20. M., 27. When slightly angry I can best let off my feelings harmlessly by swearing. If madder I feel like knocking out part of my wrath, and make awful vows of vengeance which I do not live up to.

21. F., 32. I can now generally control my naturally strong temper. I think volumes, but say nothing. It would be a luxury to wreak myself upon expression, but I refrain from prudential reasons. I know people would pay me back. I try to feel benevolently towards all, to make allowances when I feel injustice, to switch off my anger into a sort of philosophical indifference. Sometimes I get relief by working it off in an imaginary scene with the offender. My opponent says severe things and I answer still more severely, but always go off complete victor. This appeases rage, although I inwardly laugh at and despise myself, while giving this triumphant scene. I have invented an instrument of slight torture which I apply to myself, but which I shall not tell. It has helped me much. A plain two minute talk once by my older brother helped me.

22. F., 44. I get some relief occasionally by prancing about and ejaculating, especially if my heart thumps and my head aches too much. Sometimes I write a letter or even an essay on the subject, and then put it into the waste paper basket, and it has served its purpose of giving outward expression to inner wrath. If all anger has to be checked and I have to attend to conventionality, I sometimes have one of my fainting spells.

A man I know saws and chops wood in the cellar, some pound stones, children break toys, pinch themselves pound their own heads, bite their fingers, one child jumps into cold water, some tear their clothes, one must tear something, anything, one pounds the gutter pipe, another shakes a pillow, one bites a coin, several play the piano, one kicks a post, one pulls her hair over her face, some sing, take it out in imagining extreme retaliations, in inventing instruments of torture, in imaginary dialogues, fights, or other scenes in which the opponent is put at a great disadvantage. Profanity is a very common

vent, and many people have curious forms of expression, some comic, while in others it is simply round, honest swearing never heard at any other time. Scathing remarks are shouted, whispered, or perhaps merely thought. Some mutter, others walk it off, etc. This varies all the way from slight divergence from the object to something connected with it by some law of association or even utterly unrelated to almost inversion, as where excessive kindness or politeness to the enemy is the only effect observed. In some cases certain automatic movements like tapping, rocking, etc., sewer off the tension harmlessly. Just how far the pent-up energy of anger can be metamorphosed from malignant to benignant work is an interesting and practical problem for pedagogy, as well as for psychology. If education could transmute and utilize for good this great power, turning the wrath of man to praise, a great service would be done. The fact that some vents tend to become stereotyped and almost like a kind of ritual of rage suggests much plasticity, while the general fact that plenty of exercise and work, physical or even mental, provided it be not excessive, directly tends to lessen irascibility is full of suggestion in this respect.

Vents are resultants of two impulses more or less contradictory, one to react directly against the offending object and the other to struggle to inhibit that reaction. The consequence is increased psycho-physic tension and diversion to another point of escape, as a horse paws if it cannot go. Complete control would not be suppression, but arrest of all forms of expression for the rising pressure. Allbut thinks that what he calls tension, somewhat in this sense, is one of the chief psychometric criterions by which to measure both sanity and brain power. To check all vents of strong indignation would be, according to the current theories of the physical basis of emotion, to annihilate it, for if these are correct rage cannot exist without at least heightened tonicity and blood pressure, etc. These latter then, if necessary concomitants, are not vents, and control would be conceived as restricting it to these more involuntary tensions and preventing overt acts.

Change with Age. While infants scream, stiffen, hold the breath, strike, scratch themselves, chatter, kick, sob, throw, roll, etc., age almost always brings repression of these manifestations and increased control. The adult, instead of being impudent, may become sarcastic; instead of dancing up and down, may walk with heavy tread to and fro; instead of shouting, may talk to himself and use his tongue instead of fists; and while peevishness and irritability are less, remorse, reason, reflection, toleration of offences become dominant. As the mind grows there is more space for subjective expenditure of energy, and to think unutterable things that are not uttered

or to put into words the rising tide of indignation. It takes longer for an attack to reach its apex and it subsides more gradually; the effects are often less in the somatic and more in the psychic sphere; while the fact that the home, school, church and state repress by their various rules and methods the grosser manifestations of wrath, tend to make it rise to forms of expression that are more sanctioned because more refined. Conscience in some becomes a helpful deterrent, which is reinforced by religion. Physical causes are less frequent, while a larger area is exposed to psychic causes, and while capacity for anger often grows with strength and years, its frequency is generally greatly diminished. At adolescence it especially becomes more inward, while a new set of causes becomes operative. In old age temper may become serene and sweet, but if otherwise, anger grows impotent and often contemptible in its manifestations as its characteristic expressions become more limited and stereotyped. Middle life is the period when, if once thoroughly aroused, it can be most destructive, not only physically but in the world of worths. But this is the age of most intense preoccupation, most exhausting work for body and mind, hence on the whole, because other interests are so absorbing, of greatest immunity. A certain choleric vein gives zest and force to all acts, and increased manifestation of temper is one of the signs of weak wills and decaying intellectual powers.

1. M., 19. I used to abandon myself to anger, but since the age of 14 I have lived in circumstances which absolutely require self-control. I have grown to philosophize more before letting go, and can sometimes stop long enough to reflect whether I am really right or wrong. The dominant thought is the effect of the acts. As a child I used to feel that I could not act or squeal loud enough, and often wanted to kill the offender. Temper, I think, first shows itself in acts and then in words.

2. F., 31. As a child I must have been a perfect spitfire and would fight, kick and strike like a little animal, and must have been as soulless as Undine. Another little girl as bad as I fought with me, and we sometimes tore each other's hair for ten minutes. I usually came off with a great deal of triumph. About 11, chiefly under the influence of an older girl, I began to unfold a little heart and soul, and to realize that life was a little more than self-feeling and self-pleasing, when my childish temper quite disappeared.

3. F., 20. In the morning before I am fully awake, my temper is most ticklish. I am slow, but when thwarted and fully roused I am so transported with rage that I can neither move nor speak. If I can strike or throw something, my feelings are relieved as if a thunderstorm cleared the air. I end with passionate crying. Now, when I am beginning to feel these inner convulsions, I can control them better, and my remorse afterwards is deeper than it was in childhood.

4. F., 21. I find it unexpectedly hard to analyze my temper. It is bad, and I fight it constantly. When I feel myself going, I have forced myself to read of the crucifixion of Christ. At first I was unmoved, but soon tears came and I was all right. The old feeling of

fighting myself, as real as if with fists, has passed away. As a child I used to roll, to kick, and once bit my tongue. I now talk into myself. I still have the feeling that we have a right to stand up sometimes on our dignity, but still know that we should have more love and trust toward our fellow beings. I have a real sense of union with unseen powers and try to feel a oneness with the human race; and when I can, this helps me greatly.

5. F. I have diligently cultivated my natural bad temper, so as to give it the hasty, fiery form instead of the sulky one.

6. F., 21. I think I take offence quicker, but control it easier than when young. I feel temper to be childish and due to a slow, weak will.

7. F., 21. My temper has changed little since childhood. Perhaps it was then quicker and for different reasons, but not getting what I wanted has always been the chief provocative.

8. F., 22. From 12 to 16 my temper was so bad that my mother was in despair. Now the worst outbreaks have about ceased.

9. M. My temper is greatly improved since childhood. I am still quick to wrath, but it does not last. Small things trouble me most.

10. M., 18. Now I can control my fists, but not my tongue. When I do make a few remarks, I generally have the best of it. Father says I shall have to be knocked down a few times before I know enough to shut up.

11. M., 27. My disposition to passion has grown less because of a more favorable milieu.

12. F., 30. My anger confession is that when a child I slammed doors, made faces, was impudent; while now temper makes me irritable and, alas, that I must confess it, I scold.

13. F., 26. When small I would throw myself down; later clench my fists and stamp. Am far better tempered than I was, for much that once angered me does so no more. I have gained control over words and acts and feelings, and now can foresee causes of anger and thus avoid them.

14. F. My temper as a woman is so changed from that of childhood that they seem to belong to two different beings. Once explosive, I am now more morbid, peevish, and irritable. I believe it is because my life has been so unsuccessful.

15. F. As a child I rarely got into a violent rage with others of my own age, and think the reason was that I always spoke or struck out at once, and thus relieved my feelings before they had time to gather full force. With my superiors, however, fear kept my anger down until it would grow to an outburst. I always ran to an empty room, banged the door, raged and sobbed till I was tired out. Now, instead of crying, I clench my teeth and drive the nails into the palms; my heart beats so fast that I feel choked and my head seems as though it would split.

16. F., 29. I am less passionate than when younger, because I consider all sides and realize how easily people misjudge; try to be charitable, and think those with unpleasant or selfish ways worthier of pity than of blame. I want to help people struggle against their weak nerves, for I have my own.

IV. REACTION.

When the spasm or crisis of anger is passed, it leaves the system exhausted in exact proportion to the violence of the attack, and inversely as the strength of the victim. Many are faint, cold, tremble, feel weak, perhaps drop down

almost in a collapse of fatigue, and with symptoms of prostration. They have headaches, nausea, bilious attacks, tears, general mental confusion, restlessness, depression, a sense of growing old, perspiration. Many of these physical symptoms are direct reactions from an over-expenditure of energy. There are often peculiar and individual sensations, like bad odors, tastes, ringing in the ears, optical symptoms, prickling and twitching, palpitation.

The psychic reactions most frequent are mortification of having appeared at great disadvantage, humiliation for having showed low level and perhaps bestial traits, a sense of shame for lack of control, poignant regret, self pity, qualms of conscience for having broken through resolutions or other forms of restraint, renewed resolves for the future, etc.

In some cases, along with this, and still more rarely predominating over them, is a pleased sense of exaltation arising largely from the natural exhalation due to an increased sense of vitality and probably from a sense that justice has been done, judgment executed, the truth spoken, the basis for new and better understanding laid, etc. In this case there is no question of regret or contrition unless for the physical results. Here belong some of those cases who profess to have never felt a sense of guilt, however strong the outbreak. This in some cases is due to the concurrence of emotional strength with intellectual weakness, which prevents forever complete reaction to a normal state. Some souls tend to remain with reference to the offending cases where the last wave of passion left them, and although a friendship has been broken forever, justify themselves. This occurs either where mental elasticity is less, or the power to cherish grudges greater, than normal.

Yet another type rushes precipitately to the opposite extreme of self humiliation and abasement. They are abject in apologies, take over much blame upon themselves, make it a virtue to claim more than their share of the fault, and pour out their souls in superlatives of confessional self immolation and pleas for precipitate forgiveness.

Another better poised type shuns all ostentatious reversion, and though perhaps feeling that they have been a bit brutish and treasuring the lessons of regret and even remorse, from disposition or conviction, never ask pardon but quietly ignore the outbreaks, are perhaps a little over sweet, but feeling that least said is soonest mended, glide back without a word to old relations. This steadier type does not usually go quite to extremes of manifesting temper, and this mode of atonement is no doubt on the whole sanest in some cases.

In some the reaction is chiefly moral and religious, and prayer

and other spiritual exercises, together with those of conscience, play a prominent reactionary role.

Some are able to react into a sense of the humor and ridiculousness of it all. Instead of being bestial, vile, undignified, disgraceful or unhealthy, it is simply preposterous and absurd; and the penalties of ridicule and caricature self inflicted may become habitual, and very efficient as a means of restraint.

1. Irish, F., 27. I tremble all over sometimes for an hour when a temper fit is passed.

2. F., 21. When it is over, I am exhausted and cold and tearful.

3. M., 18. When reacting from a bad mad I cry, regular sobs choking me all over, although tears are less plentiful.

4. M., 31. A violent outbreak leaves me worn out in body and mind. I am strong and healthy, but after my last could hardly stand, and I felt as if I had grown older, sadder and changed.

5. F., 22. When the passion is spent, then comes the weeping fit, and then great prostration.

6. F., 22. After I have broken out badly, I am tired and restless for days. My mind whirls on its own way and takes in nothing.

7. F., 41. After a mad fit, I am pale and faint, my hands tremble so that I cannot use them and I have to sit or even lie down from sheer relaxation.

8. F., 31. Anger makes me feel worn out but peaceful. I am often frightened that I can get so angry, and often have a nervous headache later.

9. I am usually thought to be good tempered. The reason is that it takes the form of a sort of muddled wretchedness, which I can usually save up till night and fight out alone. I am always left weak physically, but mentally better.

10. M., 18. I once almost killed a tyrant boy in our school, who bullied, but did not feel half as bad as after whipping my horse. When I had done so, I would cry for an hour with my arms around its neck.

11. F., 33. I know a girl of 13 who whines, scolds and is cross all day and the next day she is abed with a bilious attack. These alarm her, and she is trying to control herself.

12. F. When a spell of rage had worn itself out, I always reflected that I would be out of favor and get no petting. Until I had no other regret and did not know it was wrong. I remember vividly when first told it was a fault, and when I tried to stop I was corrected by being sent to a corner, and sobbed violently. Few things I ever did were harder than when I made myself pick up a book I had flung down, and go on with the interrupted lesson. I often try novel reading with success. Am very sympathetic with ill-tempered people.

13. F., 40. I react by feeling that I have been a brute, try to meet my enemy as if nothing had happened, think it rarely wise to apologize, on the principle "least said, soonest mended."

14. F., 17. I am generally very contrite and want to make up by taking more of my share of the fault, and find that sometimes prayer helps.

15. F., 21. Although in anger I feel very bitter and full of burning hate toward all mankind, my reaction is intense remorse, though I never speak of it.

16. F., 26. My feeling afterward is a misery too great to speak of or even write. I know it a most dreadful sin, and remorse is deeper in proportion as the object was dearly loved.

17. F., 24. When I give way to uncalled for or long cherished anger, I feel sore and angry at myself, afterwards realizing how horrid I am and how much sweeter others are. I rarely, however, think much about anger after it is all over.

18. F., 20. My reaction is shame, seeing the other side, difficulty in speaking to the person in a natural tone of voice, realizing how small the cause was and feel that I have been a great silly. It makes me wretched that I cannot take things more calmly.

19. F., 19. It is far harder to express contrition in words than in acts, and yet if others do not apologize, my liking for them cools in spite of myself.

20. F., 28. A storm that has long smouldered in me rages on often for a long time, especially if my sister, usually its cause, is thoroughly and at once subdued. I feel humiliated in my own eyes because I have failed in what I have most desired, namely, control.

21. F., 38. I easily forget causes of anger, but never the feeling, and my constant dread is lest I shall be stirred up anew.

22. F., 21. When I think it over afterwards and see how foolish it was, I see that I must forgive as I would be forgiven and resolve to be more sensible next time, but alas!

23. F., 24. My reaction is never referring or thinking of it, or perhaps saying I did not mean to hit or being a little more affectionate than usual, amending by extra docility and sweetness with much inward disgust with myself. Sometimes I overwhelm the object of my anger with kindness.

24. F., 20. My contrition is not very deep and I detest reconciliation scenes, but glide back to normal relations without a word. To say I am reconciled, before I feel quite so, helps.

25. F., 21. At the highest pitch of frenzy, I do not care what I say or do, only striving to make it the worse, but later my remorse is awful and aggravated by punishment from parents. At these periods all my wrong deeds, especially those known to my own self, would rise up and I would resolve to confess to my father. I never came to the point of doing so, because I feared the knowledge of them would break his heart and usually ended by resolving to wait until he was on his death bed.

V. CONTROL.

Some children grow on towards maturity with no instruction that it is well to control anger and feel that not to fight on every provocation is a sign of cowardice. These cases are very rare, and experience soon teaches every child the necessity of some restraint. The simplest method is to command the voice, to speak slow, low, after a pause, and with steady and, if possible, kindly tones. Another is to relax in the jaws, arms and elsewhere the instinctive muscle tension and to undo, step by step, the attitudes and facial expressions after first restraining acts. The mirror sometimes makes a sudden revelation of ugliness that is a great aid. Repulsive and extreme exhibitions of anger in others prompt good resolves by way of warning, as do examples of great control by emulation. If one can assume even approximately the muscular expressions of the opposite state, anger cannot long persist; for its nature is very closely bound up with tensions, not all of which, how-

ever, are under control of the will. That effort in this direction is of very great psychic and pedagogic value there can be no doubt. This we may call, perhaps, the most direct way of control.

Next comes the presence of others, especially those who are respected, loved or not very well known. To have made an exhibition of temper before a stranger is so mortifying as to usually reinforce all the instincts of control. Some confess to having a very ugly or even dangerous temper, but declare that no person has ever seen its malignity. In other cases, persons with a reputation of good and even sweet tempers among their friends give way in the presence of one or two members of their own household to the vilest and ugliest outbreaks. In some families irascible children get on far better away from home, not only because their tempers are less likely to be spoiled by indulgence, but because of the constant pressure of restraint by the presence of those who do not know them well.

With the inflammable type, counting three, ten, turning around, any act or formula securing a little delay allows the slower acting powers of control to be heard from. Some temperaments can thus almost entirely burn the smoke of their own anger calentures, and for the flashy, petulant type of diathesis this alone may sometimes quite suffice.

Reflection of a moral or religious sort becomes more effective as maturity is approached. The repetition of a Bible text or some proverb not only secures delay, but brings in antagonistic motives. Recalling the compunction of conscience, the necessary acts and words of atonement, bringing in a vivid sense of divine watchfulness, the beauty of love and service even to enemies, remembering that they may have as much cause for anger as we. Sometimes ceremonies or prayerful exercises are effective.

Diversion is a great and most effective panacea. If the mind can be occupied with something else at once that absorbs it and prevents brooding, it soon glides imperceptibly into good nature and comes back to the standpoint from which offences can be regarded with equanimity.

By some or all of these methods, some bring themselves to a habitude of displaying and soon to feeling special kindness to those who injure them, although few learn to turn the other cheek to the smiter. Indeed, current ethical standards, even in the best people, hardly justify a literal fulfillment of this Christian precept. Literature furnishes a few examples of ascetic ideals, according to which imperturbability is almost in a metamorphical and even literal sense, as if thus superogatory merit were accumulated or treasure laid up in heaven. A young convert at Orchard Beach once told the writer that he

never knew such joy as when he was buffeted and insulted in his work of soul saving, and always indulged in ejaculatory thanks to God when he was cursed, struck, pelted with mud, snow or otherwise foully treated as a result of the crude methods of slum work to which his zeal had impelled him. The ethics of this frame of mind may well be doubted, and the world admires the Quaker, who at a certain point of provocation, lays aside his gray and his creed to drub an aggressor.

1. F., 18. I check rage by asking, is it right?—and try to weigh the facts. Since I was 14 I have realized how wrong anger is and can generally control it. It is very violent, but people do not know my struggles to curb it. Above all things, I hate scenes. All our family are irritable and nervous, and we have to steady ourselves. We all get on better when away from home. I sometimes try to think of all the times my enemies have been nice to me.

2. F. If I give way to my temper, I soon feel well and in love with the world and with every one in it again; but if restraint succeeds, I am miserable, overcome, want solitude, and feel that a heavy weight is hanging over me, or like a smothered volcano liable to burst forth.

3. F., 30. I have but once or twice in my life let myself go, and then went off like a whirlwind and stopped when I was ready. I almost never lose control. To restrain general irritability is far harder.

4. F., 15. A lot of girls last winter turned on me, threw snow and called me names. I wanted to pay them back, but something told me not to. I felt as if it were some one talking right to me. The girls said I was a coward, but still I did not hit them. The Bible, you know, says forget and forgive.

5. F., 40. If one I love angers me, I am simply benumbed. Bitter speeches, which I know would rankle, occur, but are never uttered. Between love and this assertion of my words, self-conflict is short, sharp, and generally results in perfect silence. I have noticed that I tap my foot and often open and shut my hands and perhaps my teeth.

6. F., 24. My temper has grown more tolerant of late, for I can sometimes check it by reflecting that others may know better, may be right, or have a right to their own opinion, that it is useless to strive or will be all the same a month or 100 years hence.

7. F., 28. I find it hard to think before I speak or to control my words, but I try to turn my thoughts to something pleasant. If I have the chance to do a person with whom I have been angry a good turn, and if I do it, which is not always the case, then all self feelings go. If my enemy makes advances by doing me a good turn, the anger goes, but then I feel remorse.

8. M., 32. To aid children in self-control, they should be taught command of the voice and hands, attitudes, and awards and punishments should be meted out with great delicacy and tact.

9. F., 22. I find some help by holding my face in my hands and smothering my screams, but must be alone where I can gesticulate and act out a little.

10. M., 27. When angry I am in a state of miserable tension all over. I feel it first about the head, in the temples and forehead. I am conscious of unwonted secretions in the stomach. I can lately help myself a little by forcing my attention to the drawn muscles and relaxing them. This makes me at least a little calmer.

11. F., 28. Control of anger I think comes largely from imitation. If children see others check rage, they learn to do so.

12. F., 19. Once I chanced to look in the glass when I was angry, and I did look so perversely ugly, that I now think twice before letting go. My face gets broad, heavy, babyish, the corners of my mouth go down and I frown awfully.

13. F., 27. Once my favorite uncle dropped into the nursery and found me on the floor kicking and screaming. He was shocked and said I looked more like a beast than a little girl. I was so ashamed that it cured me entirely.

14. F., 20. The more strangers are about, the less my irritability troubles me. Their presence is the best control. I am far worse at home. When vexed I try hard to think of something else or say to myself how much better it is to control myself or recall possible outbreaks.

15. M., 50. A murderer, awaiting sentence for crime done in a flash of anger, whom I know, told me he always carried a stick in his pocket to chew when in a rage to prevent such an outbreak as that he was to die for. When the fatal provocation came, the stick was lost, and could he have readily found a substitute, he is sure he would have done no harm.

16. I rarely felt guilty for rage and perhaps did not use to recognize my feelings as anger. There was no such self-condemnation as when I had lied. I did not apply Bible sayings about my anger to myself. As I showed anger chiefly to brothers and sisters next me in age, no adult knew how bad my temper was except the governess, who was the only one who ever spoke to me of the wickedness of anger.

Abandon. In really rare cases, there is either no power of control whatever, or else what power there is can be easily broken down, so that the individual is entirely at the mercy of his anger. If this is great, he becomes literally insane or infuriated, like animals suffering from rabies. This is sometimes seen in idiots, degenerates, imbeciles and other defectives. All fear of persons, punishment and other consequences is lost, and the individual is absolutely helpless and blind in the storm of rage. In excessive and prolonged provocation, when man is brought to bay and knows his case to be hopeless, and that he can only sell his life dearly as possible, a somewhat similar condition supervenes. This is not courage but fury, and the destructive impulse may be so strong as not to stop at any manifestation of suffering, danger, or even death to the victim, but may impel to nameless mutilations of corpses and the impulse to annihilate even self and others in the highest pitch of frenzy. Boys, who easily and really become blind mad, are usually defective or morally insane, and all extreme manifestations are generally restrained before strength or knowledge enough is acquired to make them dangerous, or they become amokers. p. 521.

1. M., 40. My boy striked when angry never quite straight, chooses a safe place like the shoulder and often with pounding down blows. Girls I have noticed are more likely to strike down. A lady I know when very angry speaks with the sweetest face and voice. Her manner is more charming than at any other time, but the things she says sting bitterly.

2. M., 29. Up to 9 or 10 my brother was so passionate as to be almost dangerous, and no punishment or disgrace affected him. He would strike wildly without aiming his blows; has thrown stools, hammer, stones and various things at me. We all used to be terrified and I used to knock him down and sit on him till he was quiet, unless some came to the rescue.

3. F., 38. I have a strong and secret dread lest anything should excite my anger. It is dreadful and I am always in hopes nothing will occur to rouse it. I fear it like physical pain. It is mental pain which I believe leaves a scar.

4. M., 30. The mother of a 14 year old boy had always vented much anger upon him, when one day for the first time in his life, he broke out with an awful volume of oaths, which paralyzed his parents and made them feel that he must be very carefully dealt with or he would be dangerous. It was, however, all game which he had put up deliberately and over which he chuckled.

5. My boy of 8 is passing through an irritable period connected, I think, with second dentition. He flies into a fury, throws, strikes, says he is crazy, and his body feels drawn up. I can see, however, that he has sense enough left to avoid doing the worst. His father, who is very nervous, believes in using the whip in extreme cases. This makes the boy pale, cold in his extremities, and nauseated. His older half sister is aggressive with him, so that his provocations are strong and frequent.

VI. TREATMENT.

Worst of all is humoring and the over-indulgence by which too fond parents are prone to spoil the temper of only or sickly children by excessive indulgence. Even good dispositions degenerate to moroseness under this regimen and a vigorous application of Dr. Spankster's tonic in such cases may work wondrous and sudden cures.

For strong, healthy children, whose will is not absolutely diseased by balkiness, whipping, if judiciously administered, greatly reinforces the power of self control. With young children it must often be a blow on the instant and without a word of warning or moralizing, and if there is a little instinctive indignation, it is all the better; and if not felt anger should often be simulated by the parent or teacher. This gives a quick sense of the natural abhorrence with which such conduct is regarded and teaches the child limitations beyond which its conduct becomes outrageous to others. Dermal pain, which is not so bad as sickly sentimentality regards it, thus comes to be associated with moral pain, both in self and others, where outbreaks occur.

Another effective method is neglect. By this the child is simply ignored, set aside from ordinary relations of intercourse, perhaps isolated as disagreeable, troublesome or sick, and thus comes to feel by their temporary loss what the ordinary relations of love, in which they live, really mean and are. It is let alone, treated with silence and affected indifference or even coolness or sadness. The social instincts are so strong

that the child soon wishes to kiss or make other signs of desired atonement, and to be taken back to the hearts of its friends as before. This method can be well developed and sustained, but with some has its own peculiar dangers and must not be carried too far.

Some are best helped by being left to the natural consequences of their acts. If they break their toys in a pet, they go without them. If they injure their clothes, bed, books, pets, they must be left to feel a sense of loss after the ruffled temper is calmed. If they litter the nursery or playground, they must slick it up, or if valuable things are endangered, they are taken away. If they treat others badly, their friendship is ostentatiously cooled. Thus they are made to anticipate the penalties of adult life.

In some, especially in small children and in those with a keen sense of humor, the risibilities may be appealed to, and the child provoked to laugh by diversion to funny acts, by caricaturing its own deeds, words, tones, appearance, and thus rage may be suddenly neutralized by its opposite.

Plain, straight talk is often effective. Sharp, incisive, graphic descriptions of their conduct, its effects, how it is regarded, its consequences when they are adult, often brings a realizing sense which increases their self-knowledge in most wholesome directions. No one can read these returns without pleading for judicious scolding, provided the time, occasion, person, etc., be well chosen. All languages are far fuller of words describing bad than those applied to good conduct, and these drastic expletives, thus at hand, should be made good use of. Perhaps it would be injudicious to advocate even a mild use of profanity as a mode of clenching or rebuking certain manifestations of temper, but surely if there is anything in the world that merits damnatory and diabolical terms, it is the extreme manifestations of rage.

In some cases I believe anger should be worked off by legitimate and regulated fighting. There are certain states of mind, sometimes provoked by certain offences, for which no ordinary modes of treatment are adequate; and to stand up squarely in a give and take conflict, whether with fists or with straight out pieces of one's mind to each other, teaches a wholesome sense of responsibility and also gives a hearty man-making type of courage. Every irascible boy at least should know how to box. Nothing is a better school of control than to face an equal in a fistic contest, and know that the least loss of temper involves a wild blow, a loss of guard, and a bloody nose or a black eye; while victory, other things being equal, is sure to rest with him who can take a stinging blow in the face or anywhere without losing his head and thus missing an opportunity.

Prophylactics should not be forgotten in cases that require special treatment. These are first of all good health, which always makes for serenity, active and sufficient exercise with regular work, absence of which is one of the surest modes by which anger material is accumulated. Primitive man had no regularity of meals, working hours or occupation, but days and weeks of idleness alternated with and prepared for by periods of excessive strain in hunting, migration, warfare, etc. Into such life rhythms, criminals and degenerates still tend to lapse, and a balanced regulation of income and expenditure of energy is the best palliative of every infirmity of disposition; congenial stated occupation acts especially as an alternative for those types of anger that tend to spontaneous monthly or otherwise recurrent explosions. Removal from irritating causes like relatives with similar types of sulks or irritability, teasing children, and a general atmosphere of kindness, affection, and freedom often work great changes.

1. F., 18. If riled I must be left by myself, for every attempt of others to soothe my ruffled feelings increases my irritation.

2. F., 19. No fear of punishment ever had the least deterrent or restraining influence. I always wished as a child, when angry, that I was grown up and could lay out the unjust person.

3. F., 20. A serious talk to me about my bad temper, when I was 16, helped me very much to both self knowledge and self control. My grandmother, who was very bad tempered, came to live with us a few years ago, and she was such an awful lesson of what I should grow to be at her age, that I improved.

4. F., 27. I think children should have it out with their rages, and that when the reaction comes, considerable reproof or punishment has its best effect. To remove causes of anger and find change of games, or playmates, to give diverting occupations and high ideals are best.

5. F., 23. I was allowed to lead in playing with other children. If they did not do as I said, I always declared that I would not play and, unfortunately for me, this soon brought them to terms. This hurt my temper.

6. F., 21. As a child I had few playmates, was much alone, and so rarely lost my temper. I had most things that I wanted and so had occupation enough to keep me from wanting much that I could not have.

7. F., As a mother of three children, whose father's family is full of nervous disease, I think perfect health the only cure of bad temper. The world is at best abnormal and civilization especially so. To make happiness a habit is to bring in the Kingdom of Heaven. If this can be evolved from a psychological laboratory, all hail to the laboratory.

8. M., 31. My mother once whipped me and then kneeled down and prayed for me. The latter made me more angry, only in a silent way, than the former. A moral lecture of being talked good to, or talked at, rarely fails with me.

9. Once F., 5, threw a favorite toy against a shelf. I put it up there for two weeks. She cast stolen glances at it daily. I also ask her, when in a pet, to say quietly, "He that ruleth his spirit is greater than he that taketh a city," and "A soft answer turneth away wrath."

10. A very sunny-tempered boy about twice a year had fits of uncontrollable rage, destroying everything within reach. These spells nearly ceased when he was about 9, but after one of them his nursery looked as if swept by a small cyclone. We never alluded to it, but let the litter lie until he took an impulse to clean it up.

11. My little brother, when in a passion, gets red, stamps, sticks to his will to the end, and, if spoken to, hits out in all directions. He is usually locked up, but the poor door suffers. When calmer, he is let out, but no notice is taken of him until a few days later, when he is spoken to seriously.

12. F., 34. My little 4-year old girl inherits considerable temper, and when she shows it I tell her she is sick or disagreeable, and to go away by herself. She soon comes back smiling and I tell her the sun is shining again.

13. F., 21. Sulkiness was my chief trait, but I suddenly and forever left it off when I was 12, when I went to live with my grandmother, who gave me a new treatment of simply ignoring me when I was sulky. She seemed to forget that I existed at such times and this made me miserable.

14. M., 28. A boy of 9 I know, when angry, used to have real spasms. The physician long treated him for extreme nervousness, but he grew no better. Another physician said it must be whipped out of him. His parents followed this instruction, and although he was very stubborn, peevish and fretful, it was whipped out of him and he never had another spasm.

15. M., 41. When my children were crying angry, I used to say, you can scream ten minutes longer, and they would have sufficient relief. Often watching the clock would divert them. Neither I nor the nurse ever say don't to our children.

16. F., 21. We can cause in M., 11, the worst fits of rage by making him laugh against his will. Punishment brings on a headache; with uniform kind and sympathetic treatment, all goes well.

17. My 10-year-old brother once cut me with a knife in rage. We learned, however, that if we cried out, you have hurt my sore corn, he would always melt to laughter, and would soon become penitent and ask pardon. His passion rarely left any trace after five minutes.

18. M., 42. Two children were very ill when they and the doctor said they must not be allowed to cry. Hence they were indulged till their tempers were spoiled. Any cross drives them into an ungovernable fury. They shriek and rave until exhausted. Their face is so changed that one would not know them, and they seem ready for any black deed. Curiously, if at the worst stage of their passion some funny word can catch their attention, they are calmed and laugh, and it all goes in a moment.

19. F., 27. At the age of 8 or 10 I fell into a state of feeling injured when everything said or done seemed aimed at me. This state recurred at intervals for many years and died out only when a great friendship and love came into my life. When I say stupid things, forget or remember too late, or plans have to be changed, I still am likely to look down, pout, stamp, be silent, etc. The sick are irritable brooding over their imagined wrongs, and self-conscious. The best way to cure this state is to break out suddenly with some funny remark or read a letter or something interesting, and it is amusing to see the change. Troubles are forgotten and happiness returns thus quickly, especially if several are together.

20. F., 24. Sometimes I can watch myself all through a tantrum, contemptuously, and perhaps laugh at my own excitement.

21. F., 22. When disagreeable and provoking things are said, I now try to laugh it off, and I find this very often succeeds.

22. F., 26. When other people are angry, it makes me calm; while if I am angry and they are calm, it makes me far more angry.

The Long During Forms. Instead of exploding, some children sulk for hours and days with little power to work it off otherwise than by making themselves miserable and diffusing an unpleasant atmosphere. This corroding state is both cause and effect of narrowed psychic range and easily grows into suspiciousness and may pass from the passive over into active and aggressive manifestations. It is hard to maintain this state without heightened self consciousness, which is prone to imagine slights, inuendoes, neglect, dislike, and may even fancy hostile schemes and plots. With a little morbid taint, suspicions of persecution may arise, especially in weak natures, and from this the passage to overt acts of vengeance has been admirably described by Magnan. Most sulkers and brooders, however, while good haters do not pass readily over to vengeance.

The law of retaliation, an eye for an eye, etc., is deeply seated in the human soul, and is closely connected with both the sense and with all the institutions of justice. Ancient and mediæval law was based upon the conception of injury for an injury, and elaborate tables of equivalents were developed. While courts now take the administration of graver matters of justice under their charge, much is still left to private settlement. In the scores of minor matters, we see in society this instinct of paying back in the same coin and which safeguards so much that is precious in life. Do others who do you, rather than the golden rule, is more germane for the natural and even for the twice born man.

Hate may be conceived as prolonged and more mentalized anger which may or may not express itself in overt acts. Usually it awaits occasion before it is heard from and it is often a strong factor in tests of popular suffrage, where those who believed themselves surrounded by friends find to their chagrin veins of disfavor where least expected.

Revenge seeks more than justice and would pay back with interest. It may be long cherished, even in the animal world, where grudges are harbored until there spite can be vented. Here we find long cherished and matured plans, the results of accumulated malice perhaps of months or years often involving calamities far beyond merit and not infrequently involving others in the doom of the victim. Among lists of infernal machines, slow poisoning, well schematized and insidious detraction, slander, libel, alienation of dearest friends, destruction of financial credit, moral or religious repute,—of all this literature, court records and individual observation abound. There are those

who can give the entire energy of their lives for long periods and even spend their treasure and take very grave risks to taste the sweets of vengeance upon an enemy. They are incapable of forgetting or forgiving, and their souls are soils in which all seeds of injury grow to preposterous dimensions. Such natures are constitutionally secretive, taciturn or cryptobiotic, and hug or nurse trifles sometimes purely imaginary until they fill the whole field of their mental vision. Had such souls the same creativeness in art, literature or good deeds, they would be great benefactors, but their passion is malevolence and destruction is far easier.

1. M., 27. A boy of 9 bore a long grudge against a shop keeper and for weeks sought an opportunity to smash his \$60 glass window. Pea blowers and small stones were often thrown and at last it was broken. The boy was glad, would not apologize and went to a reform school, although told that he would be released upon asking pardon. The worst children are those who harbor grudges and vent spite after a long interval, during which it seems to accumulate like compound interest.

2. M., 24. Boy of 12 saved his money and bought salt to put on the neighbor's lawn, and when asked why, gave a long list of mean things the neighbor had done to disturb his play. He said, "Now I am revenged, we are even, and I am happy."

3. M., 25. I know a man not of strong will but conceited, who is more discriminating and persevering in his revenge than in anything else. This he makes a holy thing and his chief object in life. He could wait for years to pay off his debts. He would even study the character of children, and relatives of his victims, to find the tender spot. Remorse he had none.

4. F., 21. In exceptional cases, as of insult, I recall and brood over every detail, holding long imaginary conversations with the person, giving her good chunks of my mind. In one case I kept doing this over and over, nursing my hate for two years. Then it suddenly went away, leaving only a half humorous contempt for the person. Even if anger fades, I never willingly have the slightest intercourse with such an one. I have always been thought to have an unforgiving character, and as a child, often did bodily harm.

5. F., 30. I know a woman who refused to speak to her husband or her daughter for a week, although living in the same house with them. She is glum, and thought all the time she was a paragon of virtue and controlled her temper because she did not speak.

6. F., 26. I believe in standing up for myself and in speaking with greater warmth and assurance of being right than I really feel sometimes. Years ago a friend spoke hotly to me and I coolly told her she was unjust. We agreed to part although I wanted to get right, but brooded over it for years. My subject of love was impaired by a sense of injury, but I have never been able to overcome it.

7. F., 30. A friend of mine is irritable, her spells lasting for days every month. She never smiles unless bitterly, contradicts everything. The world and all the inhabitants appear corrupt. Her lips are firmly set and her eyes are staring and freezing. This mood is followed by exaggerated mirth.

8. F., 18. When in temper I cannot be spoken to. I cherish a dislike, call up all previous misunderstandings, real or imaginary,

aggravate present case and make myself very wretched. I struggle to get out of these states but am more and more powerless to do so.

9. F., 42. When I was 16 a classmate lied to the teacher, saying she had helped me in an examination. I could not go to her without betraying the girl who told me, so I worked six months hard from sheer revenge, and got a higher grade certificate than hers at examination. This proved that she could not have helped me. All this time I could not say the forgiveness clause of the Lord's prayer, but she never knew I was angry.

10. F., 27. I would sulk if reproved and nurse my wrong, feeling that I was a martyr until I reached the point when I would weep. I would pout, refuse to smile, answer snappishly or not at all, and always strove to do the opposite of what was wanted.

11. M. I felt a certain triumph in sulking but do not then wish to be alone, as I do in anger. I imagine that the offender implores my pardon, which I take pleasure in refusing. Sometimes when I have sulked long enough and the person to whom I am sulking feels contrite, I sometimes wish I could force myself to the point of saying "forgive me," but I cannot.

12. M., 25. My father had terrible fits of anger, which occasionally went on for days during which he would be almost completely silent; while my mother, who is chiefly irritated by slowness as I am, is exceedingly voluble and loquacious when angry.

13. M., 25. If offended I often try to sulk in a very dignified way, but find it hard to keep this up long.

14. M., 31. My irritability, which I inherit from my father and which differs from strong passion, makes me feel as if I wanted to set everything and everybody around me flying, and then to be absolutely alone.

15. F., 32. I feel better if I can speak my mind. I have been so angry that I have felt I was possessed by an evil spirit, but it all seemed so senseless afterwards.

16. M., 25. If I dwell on things, anger grows, so I am usually angriest sometime after the cause, but rarely show it at the time.

17. F., 34. I never had but four outbursts of passion, and these were when 19, 21, 29, and 33. The cause was always injustice to self or friends, and I felt a horrid pain at what caused the anger, and immense relief at giving vent to the storm within. I never felt ashamed but often sorry.

18. F., 28. Anger must have scope or it accumulates with me. Blame rouses it most, next comes interference, although I know that often when this is by friends, it is an expression of interest.

19. Scotch, F., 19. My nasty temper never smoulders, but it is ablaze and over. I feel I must do something or explode, and must either say bitter scathing things or take violent exercise.

20. M., 38. My boy of 11 when angry, screams, speaks fast or in a gruff tone, and likes to break things. His reactions are emphatic and take the form of asking pardon of superiors, and showing excessive kindness to his inferiors. If his anger has free vent, he shows no desire for revenge later.

21. F., 27. My tempers first simmer, then boil, then explode in way that make me shake from head to foot. I am so unsettled for a long time afterwards that I find a walk the best way to work off the effects.

22. F., 26. If I repress rage entirely, from shame or any other cause, it lasts much longer. I brood over it, exaggerate the injustice and find it harder to reason myself into a happy mood of kindness toward the offender.

23. F., 37. I most dread those people, who when angry are pre-

ternaturally cool, precise and impressive. This is really the most terrible kind of passion, for you fear it may break out in anything.

24. Smothered anger that is not allowed to effervesce may become lasting and warp character, so that it is often hard to choose between the much and too little control.

25. F., 21. I do not rage but am irritable, and love to appear indifferent and even cut my acquaintances. Injustice makes the most permanent resentment.

26. My daughter of 12 is saucy, impudent, when she is provoked, but rarely revengeful.

27. F., 28. Grumbling and fault finding is the worst; sometimes trials through the day come out in the form of petulance or fretfulness when children go to bed.

Different Ways in which Individuals regard their own Anger States. The condition of rage is almost always regarded as very distinct from that of normal consciousness. The natural untaught child has at first little sense of moral wrong in this state, but soon connects painful impressions with it in his own experiences, which make for control. The instinct of seclusion, strongest with girls, and the bearing a great deal before giving way, both attest the many fears connected with this state. Threats often imply peculiar dangers if this second personality once becomes ascendant. Boys, who boast how strong they are and the cruel things they might do if mad, as though their anger was a dangerous and concealed weapon; anger, which adds more or less consciously to its intensity by feigning impulses to do unutterable things—all these are often effective in intimidating not only comrades but often parents and teachers. The simulation of anger often so admirable as a pedagogic method, the dramatic assumption of many of the symptoms and expressions of rage, are sometimes very effective in preventing fights, and a due sense among adults in society of the danger to person, property, or reputation of making active enemies and intensifying dislikes, is wholesome and sanitary. To arouse this demon, which may carry away those about us in a frenzy of rapt passion, is a danger that should never be forgotten, for where abandon is complete, the dearest friend, the fondest wife, child or even parent, may suffer an almost complete reversion, and hate, as inverted love, may become the most intense and rancorous of all. A single spasm of anger has sometimes the power in some souls of expelling affection forever beyond the power of pardon or even truce, and perhaps this "old Adam," as a potentiality, exists in every soul and may break through every fetter.

1. F., 30. Righteous wrath makes my moral sense keener, but this, I find, is very wearing to the nerves. To have a strong feeling of "served him right," when a mean thing is done, is almost a part of conscience. During the first stage of venting anger upon an opponent there is a grim satisfaction, but fortunately for the race this soon leads to shame.

2. F., 19. After a mad spell I sometimes feel repentant, often indifferent, and always very glad that my temper helped me to do what I wanted to do but otherwise never should have done.

3. M., 29. I believe in causes of offence; it is better to have the matter out, for a good rage freely vented gives an easement like the "peace which passeth all understanding, which nothing else can give and which is not of this earth." I know people who will not speak to you for a week, when you are quite at a loss for the cause, and prefer hasty tempers to the sulks.

4. M., 30. I plead for more anger in school. There is a point where patience ceases to be a moral or pedagogical virtue, but is mere flabbiness.

5. M., 31. In my experience as a teacher it is often an excellent thing to simulate or pretend anger in dealing with young children. Some faults are better punished with a little heat of anger than in cold blood.

6. F., 29. I prefer to deal with fiery than with sulky people, and am sure that a pretty good temper is desirable if not in excess. It is sometimes well to speak out that we may know and be known, and avoid misunderstandings.

7. F., 22. A strong temper well under control is a great force, and may be used for good. Heaven knows I hope it may prove so in my case.

8. F., 19. I am so often in the wrong that I seldom have a chance for righteous indignation, but I look forward to it some day, for I really like to get into a passion.

9. M., 24. It is certainly a great relief to get in a rage once in a while, but I think it should be done in solitude.

10. F., 21. The excitement is the pleasant part of my temper, and I grumble, fume and scold.

11. F., 20. A girl of prickly, contradictory disposition, balanced by much judgment, if angry never speaks, but acts. Once when 17, and told to replace some trimmings she had scissored into 100 pieces from her hat because she did not like them, she was roused to higher spirits, the deeper the disgrace. Her merriest evenings were when she had been in trouble during the entire day, and so had thrown off all restraints and revelled in the freedom from responsibility of being good. All her moods were afterwards atoned by a storm of tears.

12. Scotch, F., 24. I can generally check temper at an unkind or sarcastic remark and occasionally do not show it at all. Only once within the last ten years do I remember giving entire vent to temper, when I suddenly flew up inwardly and boxed my brother's ears. He looked so astonished that, although I was trembling with rage, I could hardly help laughing. I have found it a not altogether unpleasant sensation to be in a great rage. It wakes me up and makes me feel very much alive. I do remember once more giving way, and I shook my bigger brother till I thought I could hear his teeth chatter. If unwell or busy, I often feel very bitter and cross.

13. F., 19. The satisfaction and relief that used to make the after feeling decidedly pleasant is less now than formerly, for now it often leaves me unsatisfied, which it never did before.

14. Scotch, F., 26. When I am angry, if any one is at hand, I speak with greater heat than I really feel in order to keep up my anger. It is a kind of luxury.

15. F., 28. I used to boast and be very proud of my hot temper. It left me revengeful, sulky and skulking. Now I regret it.

16. F., 22. If deeply offended, I feel dried up toward the person for weeks and months. If I speak to the object of my wrath, my voice sounds strange and abrupt to myself. I once stood for hours in

front of a teacher whose rules I had broken, with occasionally a long-impulse to give way, but something, I suppose false pride, prevented. I felt too strange and excited to be unhappy; the latter came later. Now rage is a sort of intoxication. I am exhilarated with a sort of unnatural happiness.

17. Many boys are as I was, fond of talking of their herculean strength if angered, warning others not to make them mad, lest they be annihilated when their rage is unchained. Such boys, if angry, often look, threaten or feign to attempt the most murderous things for effect, having themselves, however, fairly well in command all the time.

18. "Don't get me mad," said M., 10, "for if I am I can lick K. S. and B. (boys of 16 to 18) and the teacher himself. I hit the old man just once in the nose and made him bleed. He has not licked me since."

19. "When I get mad," said M., 11, "I don't know what I am doing. I might take out my dirk (he only had a small pocket knife) and cut your throat or cut your heart out and eat it, or rip you anywhere like a stuck pig. I should not know what I did till afterwards."

20. "Look out, don't do that, stop, or you will get me mad!" boys often say, speaking of this state as if it were a kind of demoniacal possession in which they were no longer accountable.

21. When I am misjudged, as I often am (for this is the way I put to myself the fact that my sister is far more attractive than I and gets all the attention) I show my temper by pretending to show nonchalance. "I care for nobody if nobody cares for me" is the spirit, although I do care very much indeed. Often I never wished to set matters right, but gloried in being a martyr.

22. M., 28. I act on the impulse and speak straight out what I think, say how maddening it is, give others a piece of my mind, tell them how they should act. If they think I make too much fuss and keep cool themselves, I am all the madder. I always say all that I mean and feel easier for having spoken out, but always regret it later.

23. F., 24. If my temper is upset, I feel disobliging and disagreeable. I never had physical signs of it, and have learned to avoid those I cannot live pleasantly with. When passion rises I have to weep, and must hide lest the cause of my anger should think my tears are those of penitence, instead of righteous indignation.

27. Psychological observations, like charity, are best begun at home, and I have all my life been at home with almost nothing so much as temper, although I never spoke willingly about it before, save once to the clergyman who prepared me for confirmation at the age of 16. My confessions are not complete, but I do not know how to write some things.

Love and Dread of Seeing Conflict in Anger. Both our returns and common experiences show that many, and especially women, have great and sometimes morbid dread of any manifestations of anger as of all other uncontrolled states. In animals, females are often described as watching with complacency the conflict of their rival males for their possession, and it seems probable that the intense horror of this state, which many females report, is associated more or less unconsciously with the sexual rage which has followed it.

The great interest and pleasure in a fight, which boys, men, and sometimes even women manifest, is well attested in the

history of gladiatorial contests, tournaments, the wager of battle, pugilistic encounters, duels, whether by students or according to codes, wrestling and many other popular diversions, the crowd that always gathers to see men, boys or even dogs fight, cock fights and bull fights, etc., are further attested. The spectator's first impulse is to see fair play, and to have the contest prolonged and continued until one or the other of the contestants is subdued, and sometimes the thumbs go down, and even death is postulated. The writer himself confesses in his own experience a quite unparalleled tingling of fibre and a peculiar mental inebriation, he has himself felt in experiences of this kind, which as a psychologist and especially as a student of this subject, he has felt justified in giving himself. The common experiences of life seem dull, there is a zest of heroic achievement, of staking all for the chance of victory, of doing and daring with the greatest energy and risk, and that despite the brutality and the sense of degradation which comes from defying the ban of social condemnation placed upon witnessing such scenes. They give a sense that is to a great degree true, that life is warfare, that the struggle for survival never intermits, is always intense and bitter upon whatever plane life is lived, that offensive and defensive resources must never be out of reach, and that in a sense every one must be either a good fighter or a coward. Compared with the utterly unregulated fights of quite barbaric human beings, all these forms of conflict are more or less refined by rules or by customs, and one moral which familiarity with them impresses is that muscular strength and agility and the power to use fists and other natural weapons, and even some kind of code by which under certain circumstances certain wrongs, which the law cannot reach, can be promptly and summarily dealt with, is a distinct advantage to the ethical nature of man and a real safeguard of the highest civilization.

1. The sight of anger in others causes an awe struck yet interested wonder in the spectator, and every one flocks to see a quarrel. A boy of 11 jigged, danced and leaped up and down on witnessing a quarrel between two girls, although they attempted no physical violence, but simply stared at each other and said bitter things in a low distinct voice. If the quarrel is by older people, spectators on the other hand retire in almost inverse proportion to their sex, age, and strength.

2. F., 26. My brother, 17, once was roused to a frenzy at his brother attacking him brutally and looking awfully. He was taken to his room, and I sat by all night fearing murder, or something else still more dreadful, to follow. The next day he was silent and sullen, but gradually became himself again. This experience I cannot even now think of without shuddering.

Alas for those who consume the power of arrest or control too frequently or too completely. Many are angels or demons just in proportion as they are rested or fatigued. The state called irritability is due to loss of inhibition, and when this is gone man is the victim of whatever morbid impulses may be evoked, and some forms of insanity consist essentially in the loss of this higher power of restraint and the liberation in unchecked violence of lower instincts. Not only anger but mania, acute and active melancholy and suicide are often thus explained. Intensity of impulse, like the power of control, varies through all degrees. Some have perhaps all the wild passions, hysterical impulses, and criminal propensities in great power, but keep them so in leash that their strength and perhaps their very existence is not suspected by their nearest friends till some unusual strain removes the power of repression for a brief interval when they break out with overpowering mastery. To have and to control them, however, in some cases seems to give the tension with which the best work of the world is done. One function of education and civilization is to restrain and tutor the too quick form of response we call temper. It is always a waste of energy which passes from the potential to the kinetic form, so that control is storage of strength for either endurance or for action. The irritable diathesis involves the loss of all sense of proportion as well as perfect dignity, and weakens discipline, and "temper is a weapon we hold by the blade." We can see thus how irritability is often a stage in the recovery from disease. This lower power of reflex is restored before the higher power of control.

Lange's¹ theory of emotions, as is well known, makes vaso-motor changes primary, even to those of the neuro-muscular system. Sadness and fear are at root vascular constructions with consequent diminution of voluntary innervation, while joy and anger are vascular dilation with augmented innervation. Joy, sadness, anger, etc., are not mysterious energies causing physical states and changes; but we must drop this psychic hypothesis and say conversely that sadness, *e. g.*, is simply a more or less obscure feeling of the vascular phenomena which accompany it. If these latter could be eliminated, nothing would remain of anger save a memory of its cause. In every emotion there is an initial fact, idea, image or sensation, but the emotion itself is nothing but a sense of those organic changes which precede and condition it. To prove such a theory, as Dumas well says, we must suppress all the visceral and peripheral changes and see if this involves the loss of the emotion;

¹Les Emotions. Paris, 1895.

but this can never be done, and hence the theory is safe from experimental proof or disproof. Perhaps, however, some proportion may be established between emotional intensity and vascular instability. This view is essentially mechanical, basing feeling on physiological reflexes. The view of James¹ is that "bodily changes follow directly the perception of the exciting fact and that our feeling of the same changes as they occur is the emotion." "We are sorry because we cry, angry because we strike, afraid because we tremble, etc." These bodily changes are not merely vascular but are innumerable and are all felt. For the finer as distinct from the coarser emotions, weakened repetition of once useful acts, the Darwinian analogous feeling theory and that of easiest drainage channels, which are probably not the smaller muscles but by way of the pneumogastric and sympathetic nerves, are the three explanatory principles.

No one adequately informed on the physiological basis of psychic life will for a moment question this general view of the primacy of physical changes and no one who accepts the most cardinal principles of modern epistemology will hesitate to affirm another psychic element and to deny that the physical changes are the feelings. Not only ought these two precepts to be almost platitudes in psychology and have interest only for those still numerous, as the discussion of the Lange-James theory has shown, who hold that the soul is more or less entitive, but the same principles apply to every form of intellection as well, save only that instead of muscle tensions, blood pressures, etc., we must substitute more subtle changes in the highest nerve centers. This, too, is the only fruitful presupposition of modern psychology, vague and general as it must be in the present state of our knowledge. In all thought brain changes must be postulated as preceding in time and as all conditioning. A far better and fuller statement of this principle, so far as the emotions are concerned, has just been made, independently of and in entire ignorance of the Lange-James view, by Sutherland,² who makes an admirable digest of recent biological and psychological researches which seem to point to the conclusion that henceforth we must conceive that the emotions are to the intellect somewhat as the sympathetic nervous system is to the cerebro-spinal.

In general terms, we may say that the brain begins with the vertebrate series, and that the visceral ganglia that preside over nutrition, circulation and perhaps vascular tone, and the

¹ Psychology. Vol. II, pp. 449-450.

² The Origin and Growth of the Moral Instincts. 1898. Vol. II, pp. 210-307. The Nervous Basis of the Emotions.

involuntary and non-striated muscles affecting nutrition, temperature, sex, etc., are the twilight region where the keys to the solution of the psychology of feeling must be sought. Most of the history of life as recorded in the rocks since the amphioxus has been devoted to the development of muscles and to laying the basis of all that they presuppose for the soul; and the suggestion is irresistible that the roots of our emotional life must be traced back to those paleologic ages where prevertebrate life had its fullest development. The feelings, therefore, are indefinitely older than the will, as it is older than the intellect. Mosso and others have lately laid stress on the idea that the physical expressions of the most different emotions are often more or less similar, especially if they are intense. It is no doubt true that strong feelings are so widely irradiated as to affect every part and organ of the body; and although pleasure states are more closely related with expansion and extensor muscles, and pain with ameboid and cellular contractions and in the higher forms with the flexor muscles, it seems improbable that emotions so opposite as anger and love should not be as strongly contrasted in their expression. Probably our emotional psychology has now only advanced to a stage of development more or less corresponding to that stage in general psychology when it was first clearly seen that the brain and not the heart was the general organ of mentation, and perhaps we are now at the dawn of a period of ganglionic psychology.

PSYCHOLOGICAL LITERATURE.

Studien über Hysterie von DR. JOS. BREWER and DR. SIGM. FREUD.

This little book, although it appeared in 1895, is not so generally known by psychologists perhaps as both its interest and importance warrants. With a different purpose than the great work of Legrand Du Saulle, the present study limits itself to those cases of hysteria which are of psychic origin. These are much more numerous than has commonly been supposed, and can almost invariably be traced back to some lesion of the psychic sexual region. Psychical hysteria is defined as "der Erregung, welche abströmt oder abreagirt werden muss." The excitant is of a compulsory nature and being ideational in origin is frequently hidden from the individual himself. It may often be reproduced by the aid of a light hypnosis or by pressing the patient to the point of confession, and upon such possibility and the degree of its success rests the therapeutic procedure of the authors. The key note of the discussion lies in the endeavor to find the causes or occasions of hysteria in sudden, painful experiences, shocks of some sort, frequently sexual, apparently present for the first time but really originating in years past. The clearest dependence is established between psychic lesions or shocks and the resulting hysterias with their various sensory and motor disturbances.

The Inhalts-Verzeichniss enumerates the following topics:

Part I. The Psychical Mechanism of Hysterical Phenomena, a reprint from the *Neurologischen Centralblatt* for 1893.

Part II. A history of cases, carefully detailed and with much of psychological suggestiveness.

Part III. Restatement of the author's theory and an attempt to find a basis for the facts noted in cerebral dynamics.

Part IV. This section, not the least fruitful, deals with the psychotherapeutics of Hysteria.

Three propositions embrace the carrying power of the author's discussion. *First*: Hysteria is for the most part psychic and founded upon reminiscence. As is explicitly stated, the shock as agent does not immediately provoke the symptoms, but the memory of the psychic shock acts as a sort of strange or foreign body, remaining active for years after the first impress. *Second*: The emotional force and pathological effectiveness of such reminiscences are due to the fact that normal, adequate reactions, either instinctive or expressional, are denied them. Hysterias are conditioned upon hyperæsthetic memories. *Third*: Such memories and emotionally surcharged reminiscences tend to form separate groups, giving rise to the well known phenomena of distraction, double consciousness, sensory, motor, and organic disturbances.

The hysteric consciousness has a field of its own, its reactions multiform and varied, subject to no apparent laws. Completed in its course of development, it leads to a sundering of the soul itself. Herein it may be likened to the self of the hypnotic state, many of the phenomena of the former are paralleled in the latter. So the authors would place beside the formula, "Hypnotism is artificial hysteria," the other proposition, "The basis and conditions of hysteria are found in the existence of hypnotic Zuständen." Thus the problem

of pathological associational groups of hyperæsthetic memories, so influential and effective of bodily conditions, pools itself with the efficacy of hypnotic suggestion in general.¹

The authors assume a tendency to keep constant the intra-cerebral excitation. The regular normal expression of the emotions, the satisfaction of the fundamental needs of our being, the activities of our routine life are all aids in maintaining nervous stability. Shocks of various sorts from without, sudden fright, extreme sorrow or joy, over repression from within, too much monotony and uniformity may quickly raise the tension to the point of danger. The vegetative organs are normally insulated from the activity of the cerebrum, but under the circumstances stated, or others akin, the over tension of the cerebral excitation may break through its accustomed bounds, diffuse itself over wider areas, shunt itself into new paths. As with electric currents, weakened places of insulation may be broken through, the continuity of connection may be destroyed, or a "kurzer schluss" formed, thus laying a neurological basis for both the positive and negative phenomena of hysteria. Here belongs, too, what Oppenheim calls the "anomalous expression of the emotions," the purely motor part of hysteria.

The unique feature of the book is the method of cure as applied to psychic hysterias. In many cases, the complete confession of the circumstances and occasion of the original psychic shocks was sufficient to cause the phenomena of hysteria to vanish. In other cases, a light degree of hypnotism, or the "concentration" of the patient's attention by Bernheim's method, serves to aid the patient in recalling and reliving the occasioning factors. These, plainly and fully detailed in words, lead to the abrogation of the bodily disturbances likewise. Communication enlightens, discharges, relieves the tension, even if it be not held with the priest and followed by absolution.

The psychic process which was the point of departure must be reproduced in a manner as life-like as possible, brought in *statum nascendi*, and then detailed or confessed. Cramps, neuralgia, hallucinations, functional ailments, paralyses, anæsthesias, once in full intensity, have been caused to vanish. For example, the hysteric patient Frau Emmy (to which Freud devotes about fifty pages in detailing history, diagnosis, and cure) is the subject of successive traumatic experiences, early sexual precocity and knowledge, severe fright in various ways, attacks on the part of her brother, who is a morphine fiend, death of her husband, etc., all stored and surcharged with emotion, knit together into a pseudo-personality. These constituted a latent cause of hysteria, which always took the direction of some factor in this complex group of associational states. Treatment and cure were peculiarly difficult because "the second condition," the hysteric personality, had, as it were, so many roots, was so deeply imbedded and appeared under such diverse forms and activities. The treatment consisted, however, as in all cases of psychic hysteria, in securing repeated confession of all the shocks and morbidities and discharging the memory of the same day by day as they appeared.

A distinct tendency in this interesting discussion is to rehabilitate the sexual element as of prime importance in hysteria—a standpoint which is more or less repudiated. Freud, fresh from the school of Charcot, as he himself says, was prone to look upon the sex element in hysteria as a misnomer, but was led to a change of view by a careful

¹ Delboeuf's experiments and theory of cure by release of attention from the "life of relation" are suggestive, in this connection.

De l'Origine des effets curatifs de l'hypnotisme. Paris, 1888. A brief statement of theory may be found also in *Mind* O. S., Vol. XIII, p. 148 ff.

study of the remarkable cases detailed in Part II. The apparently correct inference from statistics that hysteria (which Dr. Weir Mitchell calls the domestic demon) increases notably during the adolescent stage of girls and immediately succeeding marriage in women, as well as the recent clinical records of Gattel, shows that the female diathesis is peculiarly susceptible to hysteric phenomena, just as paresis at the present stage of evolution is somewhat characteristically a male disease. In fact, the great functional changes and duties of woman, which mean periodic instability and tensional activity, might argue as much.

The book will thus prove suggestive to those hide-bound psychological thinkers who are over-dogmatic in fixing the limits of the normal in conscious life, as well as those who view the abnormal as *ipso facto* of no direct value to the task which psychology has ever in hand, the systematic explanation of conscious experiences.

ERWIN W. RUNKLE.

History of Intellectual Development on the Lines of Modern Evolution, by JOHN BEATTIE CROZIER. London; Longmans, Green & Co., 1897. Vol. I, pp. 519. Copious index.

This book is the first of a series of volumes in which the author sets himself the task of expounding the Intellectual Development of the world. In this volume the subject is brought down to the closing of the schools of Athens by Justinian. The evolution of Greek, Hindu, Hebrew and Christian (to 519 A. D.) thought are treated. In succeeding volumes, Mohammedanism, Mediæval Catholicism, the Revival of Learning, the Reformation, Modern Metaphysics and Modern Science, with the Doctrine of Evolution are to be dealt with; and the results of this comprehensive survey of Intellectual Development will be brought to bear upon the present problems of religion, philosophy, politics, political economy and sociology.

Hegel, Comte, Buckle and Spencer have already made attempts to reduce this history to fixed and determinate laws. But these attempts, though admirable and splendid in themselves—as efforts of the human mind to find itself—as scientific histories were foredoomed to failure. Not until our own times has a sufficient body of historical facts been brought together to justify an attempt to reduce them to fixed and scientific laws. Hegel was obliged, therefore, to enunciate a single general law for the whole field of intellectual development, instead of enunciating a number of more closely-fitting laws for its separate divisions and sections. Comte in his “three stages” shows how the *social* and *moral* phenomena of the several periods were connected, but his law was too wide and general to determine their *intellectual* curve and line of evolution. Buckle made no appreciable advance upon Comte. He merely presents the same thesis under different terms; and turns what purports to be a scientific enquiry into a magnificent piece of special pleading in the interests of a particular stage of intellectual development—the scientific or “inductive.” As with Hegel and Comte, so with Spencer. His great law of evolution is too wide and comprehensive for a satisfactory explanation of the special problem of intellectual development. The law of endless differentiation as a cosmic principle is of prime importance, but is barren as an explanation of the limited problem in question. The sky, though spanning the world, and being the abode of the gods, is useless to protect man from wind and rain. The important point is not the knowledge that a new germ of religion or morality, once planted in the minds of men, will unfold in infinite differentiations; but rather the important thing to know is how a specific intellectual advance

takes place, how a specific idea becomes modified into another specific idea.

To enunciate such a special law or laws under which the intellectual evolution of the world proceeds, is the aim of this present work. The author finds three types of cause entertained by the human mind—these three being determined by the notion they have formed to themselves of the *nature* of the cause or causes by which they conceive the world to have been produced. These he denominates, for convenience, Religious Causes, Metaphysical Causes, and Scientific Causes. Upon these three causes as constant factors in the intellectual history of the world, he seeks to reconstruct the history of Intellectual Development. Instead of regarding Philosophy, as Hegel has done, as a swelling torrent which whirls into its own current Religion and Science as mere tributaries and spoils, he has figured it as only one form of thought among several, each of which has its own laws and modes of procedure. Taking his stand upon the human mind in its ensemble, not upon some segment, he uses each of the corresponding causes in turn as a fixed point by which to measure the other—like the surveyor, who uses the height of a tree to measure the extent of a field, and the length of a field, the height of a tree.

The author confesses, with fine tolerance, that the belief in a stupendous and overarching Supernaturalism everywhere enfolded and pervading the world, is largely personal conclusion and not necessary transferable to other minds. It is therefore not pressed upon the reader, but is left to his deep moods with their finer and truer spiritual affinities and intentions.

W. S. S.

L'Idéalisme Social par E. FOURNIÈRE, *Bibliothèque Générale des Sciences Sociales*. Paris. Felix Alcan, 1898.

The author is a convinced socialist; at the same time a true scientist.

Formerly humanity, being unable to conceive of an ideal on earth, looked for its ideal in a life of dreams, after the present life. At the present time the necessity for so doing no longer exists. Science has so developed as to afford no means for the realization of happiness in this world.

The old science—*e. g.*, the discussions on the Universalia during the Middle Ages—stood entirely aloof from practical life. To-day, although engaged in work independent one of the other, they both strive towards attaining the same end. It is not necessary to give examples showing how much the recent scientific discoveries have advanced mankind towards the ideal of a socialist.

It will be found that two other steps in the same direction have been taken: co-operation, and the division of labor, which even more than the development of science are a proof of the socialistic character of modern life. It is true, however, that much remains to be done in establishing the relation between the work-giver and the worker, which, as yet, is a sort of slavery, owing to the fact that the salary does not represent the full value of the work done, the work-giver retaining part of the profit. On the other hand capitalism is in a process of transformation, it is becoming impersonal, that is, corporations take the place of private capitalists in large enterprises—a new triumph of Socialism—and those are cases even where the laborer has his share in the profit, where he has become an associate in the business.

From the standpoint of economics the result of the latter movement will be that, owing to the progress science has made, production will be so abundant that the cost of living will be reduced to nothing. All this is advanced in the strongest and most logical manner.

Not so the second part: the development of the social institutions.

First the family. Capitalism has demoralized family life. Women, having to work in factories, are obliged to leave their homes. But there is some advantage in this state of affairs; earning her bread herself, has given to woman her social independence. She now is, or will be, a "social all" just as well as man.

The relations of the individual to the State will continue to develop further. Democracy has taken the place of monarchy, and the modern man does not admit that the State has any jurisdiction in private affairs, but that it must confine itself strictly to the administration of public matters. Mr. Fournière thinks that the time will come when public laws will be useless, because man will comply with what he has himself established, he being at the same time ruler and subject. This, as will be readily seen, is more than socialistic idealism; it is the anarchistic ideal of society.

Will the socialistic ideal ever become a reality? Mr. Fournière believes in it. The first thing, then, is to have mankind understand this ideal, to have a clear image of it in its mind, so that it may learn to live up to it.

A. SCHINZ.

Le Suicide. By EMILE DURCHEIM. Felix Alcan, Publisher, 1897.

This recent French work on suicide, though marred by provincialism and prejudice affords some views that are of real value.

The author is a professor of Sociology at a provincial University and has evidently seen very little literature of recent date on the subject, for his latest statistics are mostly those of 1870 to 1875 and are largely quoted from Morselli's "Suicide," published in 1882 in the International Scientific Series.

A more recent work, "Suicide and Insanity," by Dr. S. A. K. Strahan, published by Swan, Sonnenschen & Co., in 1894, in the same series with Gronlund's "Co-operative Commonwealth," the Social Science Series has statistics for 1880 and in some cases for 1890. Durchein shows prejudice in arguing that Catholicism is less favorable to insanity than Protestantism, founding his view on statistics of Catholic countries, though on his own figures suicides are only half as frequent in England as in Austria. Later figures give England 74 suicides per million inhabitants, and Austria 144.

The real fact, which none of these writers seem to have touched, is that suicide is most prevalent in rationalistic, intemperate countries.

The real advance of the French work on its predecessors is in the parallelism traced between suicide and alcoholism (distilled liquors). The Scandinavian temperance movement may diminish suicide in the near future.

A remedy is also presented, though it is only mentioned as a punishment.

It is taken from the New York Penal Code of 1881, which punishes attempted suicide with imprisonment not to exceed two years, or fine or both. Strahan and also Durchein show that suicide is no real sign of insanity.

H. L. EVERETT.

La Religion et les Sciences de la Nature, par F. BETTEX. Genève, 1898. pp. 296.

The author first discusses progress and actual evolution, then the relations between Christianity and science, and finally characterizes and points out the dangers of materialism. Religion is not knowledge, but life; and many of its postulates could be founded on science, to which, however, some are opposed. The physical is for the sake of the moral world. For the Christian there are three revelations: conscience, nature, Scripture. It is suggestive that 25,000 copies of this work have been sold.

Religions Philosophie auf Psychologischer und Geschichtlicher Grundlage, von AUGUST SABATIER. Freiburg, 1898. pp. 326.

Sabatier's religious philosophy rests upon psychological and historical grounds, and is here authoritatively translated into German. First the psychological origin and nature of religion are considered. Then follow religion and revelation, miracle and inspiration, the religious development of man. The second part discusses Christianity, beginning with Hebraism and the origin of the Gospels; then discusses the essence of Christianity and its historical forms. The third part treats of dogma, what it is, its historical life, and development, the science of dogma and the critical theory of religious knowledge.

General Introduction to the Study of Holy Scripture, by CHARLES AUGUSTUS BRIGGS. Chas. Scribner's Sons, New York, 1899. pp. 688.

This is a very greatly enlarged tenth edition of the author's Biblical Study, 1888, which has been revised yearly for fifteen years in connection with text-book work and is now, on the twenty-fifth anniversary of the author's professorate, dedicated to the students and alumni of the Union Theological Seminary. The author's aim has been to take a very comprehensive and systematic, but somewhat superficial view of the very many special topics involved. Very much of it deals with what may be called externals, such as titles, names of authors, dates, etc., and those who look for much information on any of the special topics will be disappointed. Even such topics as the general teachings of Ritchl or Rothe, Vatke, Baur, or even just what the higher criticism holds, are treated so incidentally as to give almost no real information. We distinctly question the pedagogic method of such instruction, and think a true introduction should give far more prominence to the ideas of the different authors, and that, for instance, Paulsen, in his Introduction to Philosophy, solves this problem far better.

Die Gleichnisreden Jesu, von D. ADOLF JULICHER. Freiburg, 1899. pp. 643.

The author is one of the younger representatives of the new theology and it is this book upon which his reputation largely rests. The present volume is devoted to thirty-three parables, likenesses, and illustrations used by Jesus; and this affords the author an opportunity of not only displaying his very wide range of textual knowledge, but also of illustrating in the most effective way the leading tenets of liberal or higher criticism, which he represents.

The Evolution of Christianity, by RAMSDEN BALMFORTH. London, 1898. pp. 161.

The true view of the Scriptures and the forces that made it are first characterized from the inside. The beginnings of Christianity, which depend upon the question whether Jesus was divine or human, and the doctrine of the atonement follow. The organization and doctrine of the church, the mediæval reawakening and the definition of true religion are the other topics. The author's standpoint is distinctly liberal and ethical, and his creed is the Fatherhood of God and the Brotherhood of Man.

Ethics and Revelation, by HENRY S. NASH. The Macmillan Co., New York, 1899. pp. 277.

The writer discusses the relations between ethics and religion, the

spiritual significance of the free state, comparative religion and the principle of individuality, the church's conception of revelation, prophecy and history, Christ and the creative good. Their aim, conformably to the will of the founder of the Böhlen lectureship, is to show "that the Bible marks out the road along which conscience must travel if it would treat our life on earth with abiding seriousness." The writer is a professor in the Episcopal Theological School at Cambridge, and the author of *Genesis of the Social Conscience*.

A Manual of Patrology, by WALLACE N. STEARNS. Charles Scribner's Sons, New York, 1899. pp. 176.

This is a concise account of the chief persons, sects, orders, etc., in Christian history from the first century to the Reformation, with select biographical references. An infolded map and chart with several tables add greatly to the value of the work, which is almost as concise as a dictionary.

Essay on the Bases of the Mystic Knowledge, by E. RÉCÉJAC. Charles Scribner's Sons, New York, 1899. pp. 287.

The writer first discusses the various attitudes of the mind towards the absolute, empiricism, criticism, etc., then the mystic consciousness which knows God through the heart is characterized, together with the symbols expressing such knowledge. Mystic esotericism is simply the intensified state of consciousness we know as inspiration. Mystic intuition reveals freedom and God, but is always in part incommunicable. The mystic city is the characterization of an ideal state in which the heart and not the head shall dominate.

Die Funktionsstörungen des Grosshirnes, von ALBERT ADAMKIEWICZ. Hanover, 1898. pp. 242.

This concise and comprehensive study, after a general account of physiology, psychology, histology and symptoms, takes up first the mechanical and then the functional diseases of the cortex, the latter including all the anomalies of sleep and dream; and thirdly stimulus and laming are discussed. The second part is devoted to a summary of what is known concerning cortical areas and localization; and the third treats of the substance of the hemispheres, cells, fibres, etc. Three interesting colored charts are appended.

Vererbung und Entwicklung, von MAX KASSOWITZ. M. Perles, Wien, 1899. pp. 391.

Of the fifty chapters that compose this volume, which although finished in 1897 is now printed with a little change, the most important are—the origin of life; the primeval cell and nucleus; assimilative continuity; changes by mechanical influences; correlation between blood vessels and bones; changes by nervous stimulation; individual adaptation; the impotence of natural selection; sexual selection; the inheritance of acquired character; innate nerve mechanism; amphimixis; Lemarck and Darwin; germinal selection; social instincts.

Essays in Psychological Research, by MISS X. (A. Goodrich-Freer). George Redway, London, 1899. pp. 330.

These papers, collected from various periodicals, discuss haunted houses, crystal gazing, the divining rod, hypnotism, obsession, psychic healing and Saint Columba. They are written in a lively and interesting style and from a sympathetic standpoint.

Arbeiten aus dem Gesamtgebiet der Psychiatrie und Neuropathologie, von R. v KRAFFT-EBING. J. A. Barth, Leipzig, 1897-1899. pp. 207.

These four volumes in one comprise some score and a half of miscellaneous papers published by the author in various journals between 1878 and 1898. The topics most fully treated are—transitory insanity on a neurasthenic basis; the imitation of organic nervous diseases in hysteria; clouded and dreamy states; imperative ideas, sexual psycho and neuropathy; the latter comprising over 100 pages of new matter.

Lehrbuch der Psychopathologischen Untersuchungs-Methoden, von R. SOMMER. Berlin u. Wien, 1899. pp. 399.

This valuable work comprises an introduction on methods in scientific psychopathology and four parts: (1) optical, (2) moto-graphic methods on knee, pupil, hands, etc., (3) acoustic, and (4) on psychic states and conditions, including memory, number work, association and time. There are in all 85 curves and figures.

La Dissolution Opposée à l'Évolution dans les Sciences Physiques et Morales, par ANDRÉ LALANDE. F. Alcan, Paris, 1899. pp. 492.

After one chapter each upon mechanical, physiological, and psychological dissolution, the author discusses social dissolution and its consequences in law. The latter is brought about by excessive division of labor, assimilation of sexes, the dissolution of family and of ethnic groups.

L'Instabilité Mentale, par G. L. DUPRAT. F. Alcan, Paris, 1899. pp. 310.

We have here an essay on the data of psychopathology. All mental functions are characterized by instability, personality no less than others, and morbid stability is especially seen in sex function and age. The practical conclusion is an account of what the author calls mental therapeutics and preventative pedagogy. The writer's standpoint is purely psychological and is largely based upon the distinction between psychic continuity and discontinuity. Philosophers should not give over to doctors the business of curing mental diseases, but should themselves study the pedagogy of firmness and coherence of will and character.

Primer of Psychology and Mental Disease, C. B. BURR, M. D. F. A. Davis Co., Philadelphia, New York, Chicago, 1898. pp. 116.

This little manual is designed for use in training schools for attendants and nurses. It is an extremely elementary primer in psychology, morbid and especially normal.

Psychiatrie und Seelsorge, von A. RÖMER. Berlin, 1899. pp. 343.

Dr. Römer presents here a guide for the recognition and avoidance of the nervous evils of our time. The psychoses he treats are grouped under the three heads of organic, idiopathic, and constitutional. Very interesting is his discussion of transitory losses of responsibility as contrasted with permanent loss. The last part of the book is devoted to a discussion of the assumption and consequences of his doctrine and of answering four objections to it. That it exhausts the body at the expense of the mind, that it denies freedom, that it reduces the worth of personality, and is unbiblical. The conclusion of the work discusses the personality of the shepherd of souls among the insane, and he pleads for the institution of such a special office as practicable and necessary.

Wild Animals I have Known, by ERNEST S. THOMPSON. Charles Scribner's Sons, New York, 1899. pp. 358.

This is a volume of stories about wolves, crows, rabbits, dogs, foxes, mustangs, partridges, with copious and other artistic illustrations, and written in a charming style, which characterizes this clever author artist.

The Brain Machine, its Power and Weakness, by ALBERT WILSON. J. and A. Churchill, London, 1899. pp. 151.

This is one of those books in which a man evidently of years and experience has undertaken to put down his general view of life. He happens to be a doctor, and holds that prosperity in this world and perhaps salvation in the next depends upon the health of the brain cell. Hence, together with a discussion of cranial nerves, automatisms, speech, etc., marriage, religion, crime, alcohol, suggestion, education, and many other topics are discussed. The latter part of the book contains thirty-seven rather rude cuts of various objects illustrating his subject.

Geschichte des Lebensmagnetismus und des Hypnotismus, von H. R. PAUL SCHROEDER. Leipzig, 1899.

In the five lieferung, ending with page 288, that have so far appeared, the author has brought his history down into the time of Mesmer. His work abounds in various illustrations and pictures of prominent representatives in the fields treated.

Hypnotism and its Application to Practical Medicine, by OTTO GEORG WETTERSTRAND. G. P. Putnam's Sons, New York and London, 1897. pp. 166.

Dr. Petersen has rendered a very valuable service to both psychology and medicine by translating the valuable contribution of Dr. Wetterstrand on this important subject. The very remarkable cures and ameliorations of stuttering, hysteria, chorea, light psychoses, insomnia, neuralgia, spasmodic movements, alcoholism, incontinence, etc., by this author's method of prolonged and artificial hypnotic sleep, constitute not only a contribution to modern medical methods but also to psychology.

Twentieth Century Magic, by NEVIL MONROE HOPKINS. New York and London, 1898. pp. 160.

This book deals largely with the construction of the newest magical apparatus in which mechanical, electrical and other experiences are involved. The magician's stage and tables are first described, then five new and rather choice bits of mechanical magic. Chemical and electrical magic follow. In all there are just 100 illustrations.

Sexualismus und Aetiologie, von G. HERMAN. Leipzig, 1899. pp. 116.

This is the first part of the first volume of a natural history of love designed as a contribution to sexual physiology. The author styles himself professor, and his captions are energetics and polarity, organs, contrectation and detumescence, living substance, physiocratic and psychocratic procreation. These, perhaps, give sufficient intimation of the mystic character of this work, which is nevertheless based to a great extent upon a study of recent morbid and normal physiology.

Psychologie Comparée de l'homme et de la femme, par C. RENOZ. Paris, 1898. pp. 576.

In the first part the author discusses masculine and feminine psychology in general, with sections on egoism, envy, anger, doubt, pessimism, modesty, chastity, etc.; in the second part, the relations of the sexes are treated, morbid and normal; and in the third, the struggle and rivalry between the two resulting in the supremacy of man; in the last, the effort to equalize the liberty and opportunity and to lay down laws for each.

The Last Link; Our Present Knowledge of the Descent of Man, by ERNST HAECKEL. London, 1898. pp. 156.

The author here attempts to resumé his more comprehensive, systematic phylogeny and present a concise picture of our present knowledge of the descent of man. The evidence from comparative anatomy, paleontology, etc., is first stated, and then the various stages from worms up, twenty-six in number, are briefly characterized and two new illustrative charts are printed. The second part of the book, beginning with page 80, is devoted to short biographic sketches of great biologists, and to notes on the theory of cells, factors of evolution and geologic time.

A System of Ethics, by FRIEDRICH PAULSEN. Charles Scribner's Sons, New York, 1899. pp. 723.

While less concrete and empirical than Sunderland's, the present treatise is far more so than we should expect from the author. Five chapters outline the history of moral philosophy, nine its basal concepts, and nine more the doctrines of virtues and duties. Sub heads abound in practical themes like drunkenness, clothing, poverty and wealth, modesty, suicide, temperance, justice, effects of welfare on character, nihilism, egoism, relations between science and religion, immortality, freedom, compassion, love of home, country, gratitude, lying, and flattery.

L'Automatisme Psychologique, par PIERRE JANET. F. Alcan, Paris, 1899. pp. 496.

This new and enlarged edition of this important work distinguishes first between total and partial automatisms. Under the first head, catalepsy, somnambulism and suggestion are discussed. Under the second, subconscious activities, anesthetics, and psychic disintegration.

La Psychologie Naturelle, par W. NICATI. Paris, 1898. pp. 423.

M. Nicati is bitterly opposed to current psychology because of its implications of supernaturalism and regards it as essentially a physical science tributary to others and divided into two general parts—one dealing with individuals and the other with society. Just as the parts of the individual are related to each other, so individuals are related to society, and the present work is preliminary to a larger general and social psychology. The present work treats solely of colors and is devoted to discussions of their scales, the mechanism of color in the senses and nervous centers, its gradations; and the second part treats of individual psychology, regarding individuality as a common attribute of forces as affirmed in the distinction between soul and body, and as culminating in determinations of the intensity of psychic and nervous force shown in electricity, cellular tropisms and movement, general sensibility, etc. The chapter on emotions makes it a basis of sensation, memory, knowledge, etc. Intelligence is a mechan-

ism, and in rudimentary forms is seen in viscera and vaso-motor ganglia as well as in the basal ganglia of the brain, which he thinks the cerebral seat of instinct; while higher intelligence is manifested in the brain. Psychic harmonies are classified as intensity, space and time, and are grouped in symphonies not without analogies to music. In general, unique and stimulating as is the author's standpoint, original as are his many illustrations, it must be granted that he has undertaken a work which in the present conditions of our knowledge must for a long time, to say the least, remain incomplete and unsatisfactory.

L'Avenir de la Philosophie, par HENRI BERR. Paris, 1899. pp. 511.

Professor Berr attempts here to sketch the synthesis of knowledges founded upon history. First a brief sketch of philosophy since Descartes is presented as a basis of critical, positive and ethical conclusions. Philosophy is to transform its metaphysical into scientific problems, and to effect a great synthesis not only of knowledge but of life and religion, which is to affect man and society in the profoundest and most beneficent way.

Psychologie als Erfahrungswissenschaft von HANS CORNELIUS. Leipzig, 1897. pp. 445.

The problem here attacked is the epistemological basis of psychology, which he would base on purely empirical to the exclusion of all metaphysical conceptions. The contents of consciousness, memory, recognition, association, abstraction, speech, definition, and feeling are the elementary facts. On their bases are discussed unity and expectation, subject and object, the unity of personality. The third chapter attempts psychic analysis of the unnoticed contents of consciousness; and in subsequent chapters sensation, memory and fancy, the objective world, truth and error, feeling and will, are treated.

Die Seelentheorie, von F. HANSPAUL. Berlin, 1899. pp. 292.

The laws of natural egoism and adaptation, together with the pedigree of the human spirit, might have been the title of this book. In one chapter the influence of speech upon the brain, in others the effects of association, the relations of egoism to society, the insufficiency of Darwinism, the justification of punishment by the State, are discussed. From these standpoints the author attempts to show that the soul is as old as the body and begins with the primeval cell, that it has persisted in a chain of continuous development for millions of years, and will perhaps develop into unknown forms millions of years hence; for life, egoism, will and understanding are all one and the same thing, whether in plant, animal or man.

System der Philosophie, von JOSEF MÜLLER. Mainz, 1898. pp. 372.

The fruit of twenty years of philosophical study is here presented in condensed form in the belief that it fills a gap. Philosophy now is less in need of originality than of accuracy. The center of the author's view is his theory of consciousness. The book falls into three general divisions: (1) epistemology, logic and metaphysics; (2) psychology; (3) ethics, with an appendix on the philosophy of religion.

Der Wille und die Freiheit, in der neuern Philosophie, von MAX KRIEG. Freiburg im Breisgau, 1898. pp. 40.

This physiological study is divided into two parts—pre-Kantian and post-Kantian. Under the first, Descartes, Spinoza, Leibniz and

the English philosophers are discussed; under the latter, Fichte, Schelling and Schopenhauer.

La Nouvelle Monadologie, par CH. RENOUVIER et L. PRAT. Paris, 1899. pp. 546.

A careful characterization of the nomad is first given from various standpoints in all its orders and relations. The composition of monads follows and there are chapters each on passion, will, society, and justice. As an orderly digest of Leibniz' work, it is the most co-ordinated and systematic we have ever had.

Esprits Logiques et Esprits Faux, par FR. PAULHAN. F. Alcan, Paris, 1896. pp. 362.

The most important part of this perhaps too neglected book is the characterization of logical types. The equilibrators, the reasoners, the outrancers, the pugnacious type, the contrasters, the associators by contiguity and by resemblance. The false or illogical minds are those characterized by predominance of directive ideas or of insufficiency of them, of abnormal phenomena, the sentimentalists, the detailers, the frivolous and the puerile.

Psychologie der Veränderungsauffassung, von L. WILLIAM STERN. Breslau, 1898. pp. 264.

The sources of our knowledge of change are due to perception, reproduction and comparison. The fineness of it is measured by an elaborate technique for each sense. The psychic excitability for changes and their law is affected by fatigue, rapidity of motion, intensity, direction; and under these captions the entire discussion of the book falls. It is illustrated by various tables with curves and some apparatus:

R. Rothe's Speculatives System, von H. J. HOLTZMANN. Freiburg i. B. 1899. pp. 269.

It is one of the noteworthy signs of our time that Richard Rothe's opinions should now attract so much attention in theological circles. No doubt he deserves a place next to Schleiermacher's as one of the most original religious thinkers of modern times, and it is therefore a very opportune piece of work to digest his views in a compendious form. First his speculative principles are treated, then his general view of God, the world and man, next his principles of ethics, individual, piety and love, then his doctrines of sin and atonement, virtue, duty, State, church and the final close of all things. From superficial glances through a few chapters we think this work is well and conscientiously done.

Critériologie Générale, par D. MERCIER. F. Alcan, Paris, 1899. pp. 371.

The general theory of certitude is here treated in its origin in the different fields of ontology and logic in its relations to doubt, scepticism and dogmatism, and especially with reference to the philosophic theories of the criterion of knowledge. The different forms of criticism and the problem of objective reality conclude the book.

Journal of the Anthropological Institute of Great Britain and Ireland. London, February and May, 1899.

The long articles in this first number of a new series are on The Hill Tribes of Central India; Caves, Shell Mounds and Stones in South Africa; Totemism; and the Presidential Address, January, 1899, by F. W. Rudler.

Nouvelles Esquisses de Philosophie Critique, par A. SPIR. F. Alcan, Paris, 1899. pp. 146.

A brief life of the author fills the first twenty-seven pages. The topics discussed are: The Nature of Common Sense; The Role of Idealism: Force, Change, Order, Finality and Evolution in Nature; The Foundations of Religion and Morals; and Immortality.

The Emotion of Joy, by GEORGE VAN NESS DEARBORN. Psychological Review, April, 1899. pp. 70.

The chief conclusions here reached are that extra emotions consist in outward expansive and in contraction of extensor muscles, to which habitual inhibitions of civilized life supply the apparent deficiency in the kinæsthetic theory of human emotions. The contraction of extensor muscles is more pleasant than that of flexors.

Die Abstinenz der Geisteskranken und ihre Behandlung, von HERMANN PFISTER. F. Enke, Stuttgart, 1899. pp. 88.

This is a discussion of the causes, symptoms and cures of the persistent refusal of food, so often found in the insane asylums.

Conduct and the Weather, by EDWIN G. DEXTER. Psychological Review, May, 1899. pp. 103.

In this very interesting study, the author sums up results of his own continued investigations upon the subject, from which he reaches the following conclusions: that meteorological conditions directly affect metabolism; they also influence the reserve energy capable of being utilized for processes other than those of the vital organs; they influence the emotional state and the two last determine conduct. The latter, and also death and labor of mind and body, bear very different relations to reserve energy.

Zur Analyse der Unterschiedsempfindlichkeit, von LILLIE J. MARTIN und G. E. MÜLLER. J. A. Barth, Leipzig, 1899. pp. 233.

This comprehensive and very acute experimental investigation was conducted by an American lady in Müller's laboratory in Göttingen. After describing the methods of experiment, the second chapter discusses the enormous differences of the numbers obtained in right judgments; the third takes up the influence of time; the fourth, miscellaneous circumstances which influence the differential sensibility investigated; and the fifth treats of adjacent or supplementary comparisons.

Einleitung in die Vergleichende Gehirnphysiologie und Vergleichende Psychologie, von JACQUES LOEB. J. A. Barth, Leipzig, 1899. pp. 207.

This interesting comparative study of brain and soul is conducted with special reference to invertebrates and describes experiments upon actinia, echinoderms, worms, orthopods and mollusks; discusses the theory of animal instincts, heredity, the relation between brain and soul, and suggests future points of attack for the study of the mechanics of brain and activity.

Elements of Alkaloidal Aetiology, by A. M. BROWN. Henry Kimpton, London, 1889. pp. 86.

This is an introduction to the study of auto-intoxication in disease and is a popular summary of a larger work by the author, and gives the views of Selmi, Liebrich and Gautier.

Die Nervenkrankheiten des Pferdes, von HERMANN DEXLER. Franz Deuticke, Leipzig und Wien, 1899. pp. 277.

This interesting and very original book discusses the subject under four heads—diseases of peripheral nerves, of the spinal cord, of the brain in its different parts, and neuroses.

Studies from the Psychological Laboratory, Directed by JAMES R. ANGELL. University of Chicago Contributions to Philosophy, Chicago, 1899. Vol II, No. 2, pp. 615.

This interesting pamphlet contains the following studies: one on overestimation of vertical as compared with horizontal lines; a study in habit; the relations between certain organic processes and consciousness; habit and attention; modifications of the relations of dermal and optical space; the intensity of light as affecting visual estimates in depth; the most important paper being the third.

The Psychology of Reasoning, par Alfred Binet. Open Court Publishing Co., Chicago, 1899. pp. 191.

This work is based on experimental researches in hypnotism. After defining perceptions and images, the author describes reasoning in perception and the mechanism of reasoning, and insists that the two are at root the same. Reasoning is a kind of supplementary sense, the single type of all intellectual operations and is an organization of images.

University of Iowa Studies in Psychology, Edited by G. T. W. PATRICK. 1899, Vol. II, pp. 163.

To this interesting volume Professor Patrick himself contributes articles on *The Analysis of the Taste Perception* and *Some Peculiarities of the Secondary Personality*, while Dr. Seashore determines various psychological statistics and describes new apparatus.

La Prostitution Clandestine à Paris. Par le DOCTEUR O. COMMENGE, médecin en chef du Dispensaire de Salubrité de la Préfecture de Police. Paris, Libraire C. Reinwald, Schleicher Frères, Éditeurs, 1897. Vol. XI, pp. 567.

This is a solid and authoritative book, written by one who has had unusual facilities for the study of its subject, and who has spared no pains to attain to accurate results. M. Commenge began collecting the material for his work in 1887; and we may truly say that he has done for "private" prostitution what his predecessor, M. Parent-Duchatelet, did for "public."

The chapters are entitled: the causes of prostitution in general, and of private prostitution in particular; arrests, and their results; the Dispensaire de Salubrité, and its special function with regard to unregistered prostitutes; classification and statistics of venereal disease; the Infirmerie de Saint-Lazare; the sources of supply of unregistered prostitutes; their previous occupations; their life subsequent to medical treatment and discharge; registration and control. The writer makes a strong plea, on statistical basis, for state control and police registration.

E. B. T.

Contributo allo studio dell' automatismo psicologico per autosuggestione del Dott. G. ANTONINI. Riv. Sperim. di Fren. (Reggio in E.), Vol. XXIV (1898), pp. 626-654.

This interesting study, meant to throw light upon the mediumistic and spiritistic phenomena, which of late have almost monopolized the attention of certain psychologists, deals with the autosuggestive

psychic automatisms of T. Teresa, a young woman 28 years of age, whose first hysterical attack occurred in 1890, brought on probably by persecutory ideas, and who wrote a number of letters in the name of other persons, conscious knowledge of which she seemed not to possess. Dr. Antonini considers the case one of great importance, since the phenomena are remarkably like those of the slate and other writers among the so-called "mediums." The autosuggestion in both cases is much the same and to the persecutory delirium of Teresa may correspond the "faith" of the mediums, both giving a certain logic to their productions.

ALEX. F. CHAMBERLAIN.

L'Isterismo infantile. Studio critico e contributo clinico del Dott. AURELIO LUI. *Ibid.*, pp. 745-771.

In this article Dr. Lui gives an excellent *résumé* of the most recent discussions of infantile hysteria, besides two observations of his own and bibliography of over 50 titles. The frequency of hysteria seems to be greatest between the eighth year and puberty; girls suffer somewhat more than boys, but in the early years the difference may be very small, the sexes being as yet not so markedly divergent; heredity and errors in the education of the child are important factors; onanism has rather a predisposing than a causal value; bad nutrition and its train, infectious diseases, imitation, etc., play their significant rôle. Noteworthy is the enormous psychic hyperæsthesia and excessive impressionability and irritability of character in hysterical children, and their tendencies towards precocious development. One must be careful, however, to distinguish the simply nervous from the hysterical and by watching the development of the psychic habits of the child detect the outburst of real hysteria. While suggestion in the waking state is universally commended, much difference of opinion exists as to hypnotic suggestion as a therapeutic in infantile hysteria, Dr. Lui holding, with Joffroy, that the latter should only be used in the gravest cases, if at all.

ALEX. F. CHAMBERLAIN.

Sull' Influenza dell' insonnio sperimentale sul ricambio materiale. Ricerche del Dott. GIULIO TAROZZI. *Riv. di Patol. Nerv. e Ment.* (Firenze.) Vol. IV (1899), pp. 1-23.

Detailed account, with many tables of experiments concerning the effects of insomnia upon the organic metabolism of adult dogs. The general conclusion is that "there exist special mechanisms, regulative of the metabolisms, and when the function of these is once interrupted, 'organic failure' rapidly supervenes, followed by death,"—in the cases under consideration death occurred at from one to 4 days. It would appear that under these abnormal conditions the elimination of N is sensibly increased only at a very advanced period of the experiment—the augment continuing till death; the H_2 , SO_4 and the P_2 , O_5 present no constant characteristic modifications, while the Cl diminishes constantly in the last days before death.

ALEX. F. CHAMBERLAIN.

Ricerche sperimentali sull' origine di alcuni errori della memoria del Dott. JACOPO FINZI. *Ibid.*, pp. 101-110.

The conclusion arrived at by the author, whose researches are to appear in Kraepelin's *Arbeiten*, is that "the errors of memory are, within certain limits, a normal phenomenon in the process of the fixation of recollection,"—the principal source of error being in the action of the impressions previously fixed.

ALEX. F. CHAMBERLAIN.

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- L'Année Philosophique (9e année, 1898). Publiée par M. F. Pillon, avec la collaboration de MM. Renouvier, Hamelin et Dauriac. Félix Alcan, Paris, 1899. pp. 316. Price, Fcs. 5.
- L'Année Psychologique (5e année, 1898). Publiée par Alfred Binet, avec la collaboration de H. Beaunis & Th. Ribot. Schleicher Frères, Paris, 1899. pp. 902. Price, Fcs. 15.
- BINET, ALFRED. The Psychology of Reasoning based on experimental researches in hypnotism. Translated, from the second French edition, by Adam Gowans White. The Open Court Pub. Co., Chicago, 1899. pp. 191.
- CHURCH A., AND PETERSON, F. Nervous and Mental Diseases. With 305 illustrations. W. B. Saunders, Philadelphia, 1899. pp. 843. Price, \$5.
- DUPRAT, G. L. L'Instabilité mentale. Essai sur les données de la psycho-pathologie. Félix Alcan, Paris, 1899. pp. 310. Price, Fcs. 5.
- GÉRARD-VARET, L. L'Ignorance et l'Irréflexion. Essai de psychologie objective. Félix Alcan, Paris, 1898. pp. 296. Price, Fcs. 5.
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- LALANDE, ANORÉ. La dissolution opposée à l'évolution dans les sciences physiques et morales. Félix Alcan, Paris, 1899. pp. 492. Price, Fcs. 7.50.
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- PAULSEN, FRIEDRICH. A system of ethics. Edited and translated with the author's sanction, from the 4th revised and enlarged edition by Frank Thilly. Charles Scribner's Sons, N. Y., 1899. pp. 723. Price, \$3.
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- RÉCÈGAE, E. Essay on the bases of the mystic knowledge. Translated by Sara Carr Upton. Charles Scribner's Sons, N. Y., 1899. pp. 287. Price, \$2.30.
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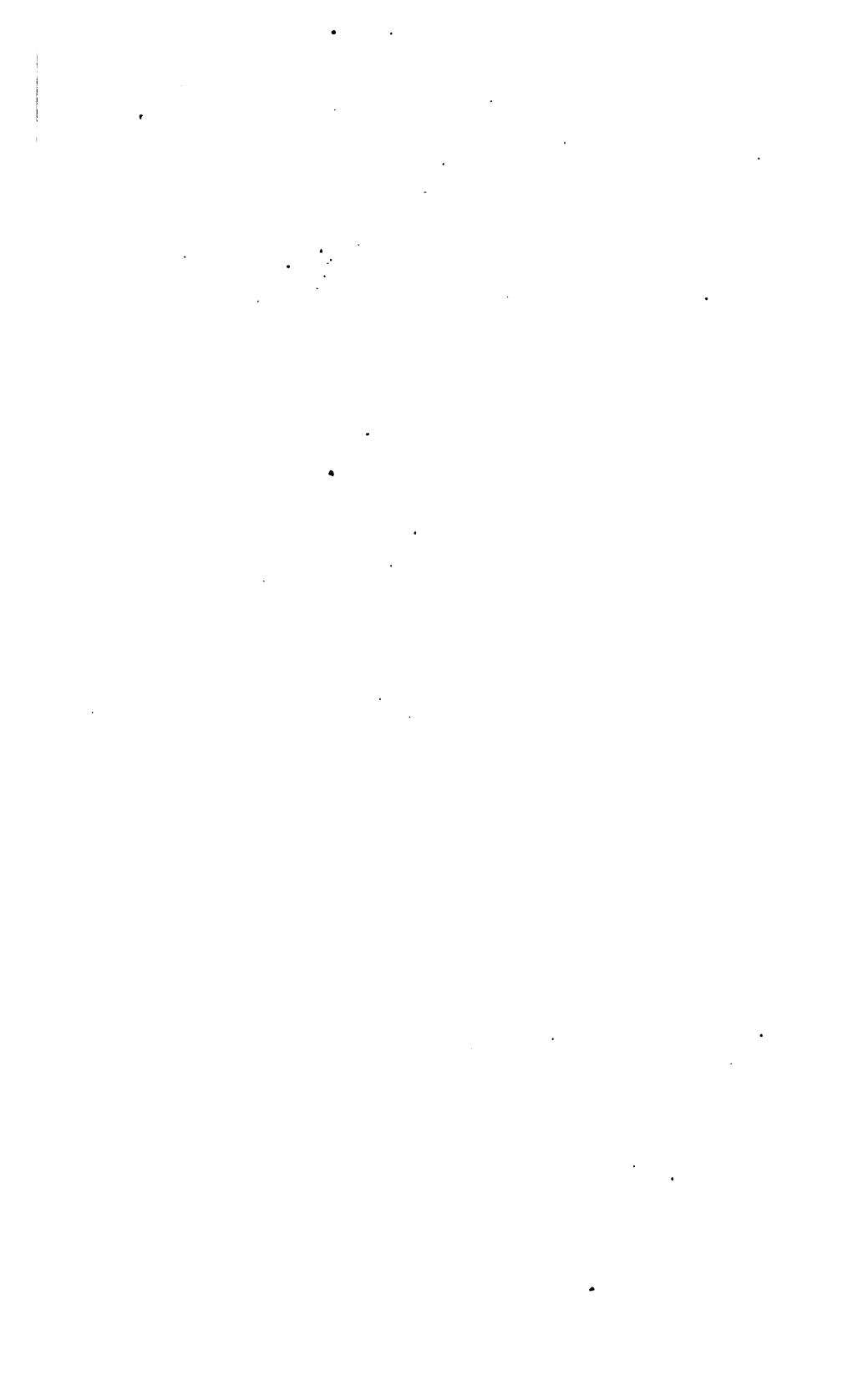
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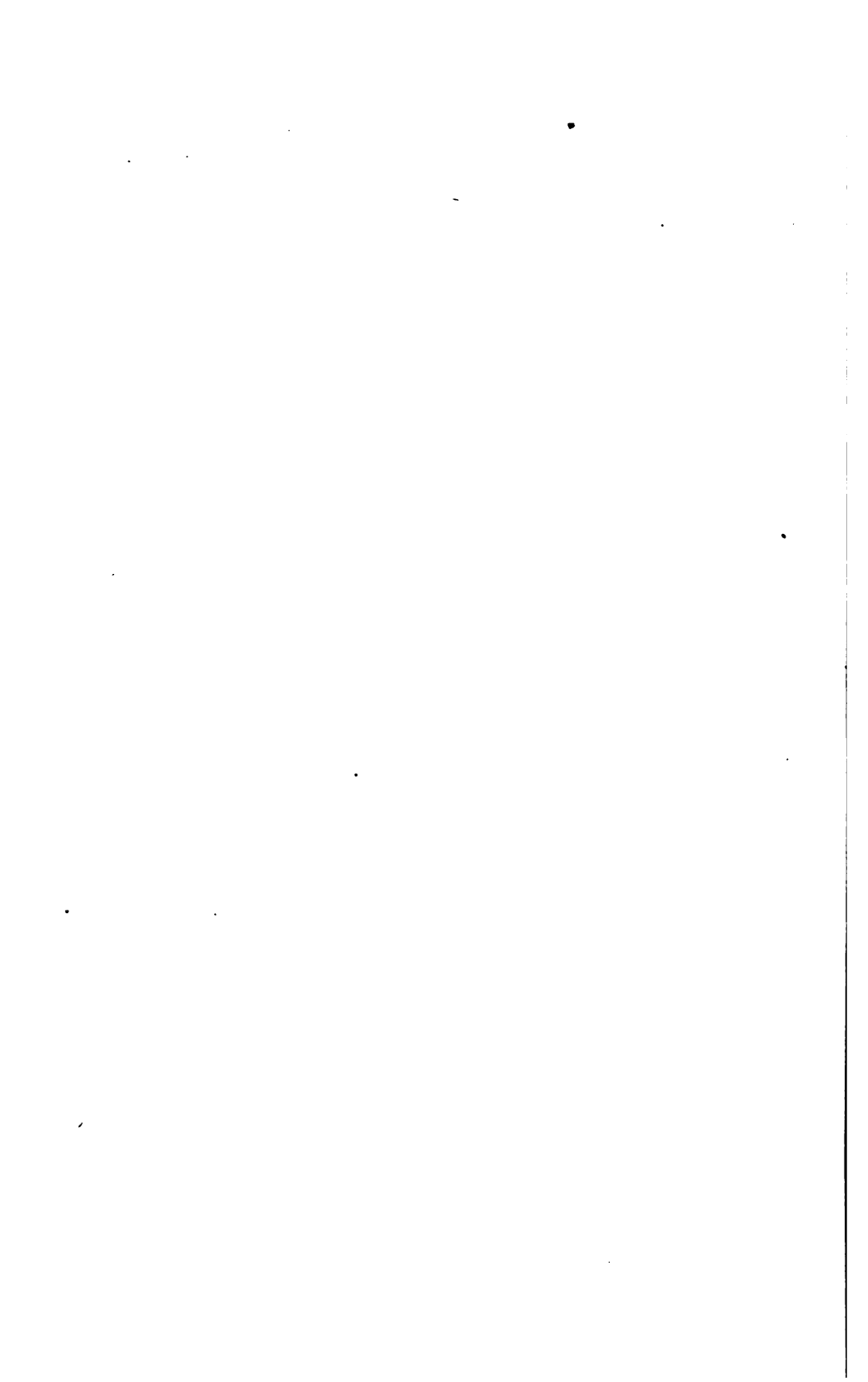
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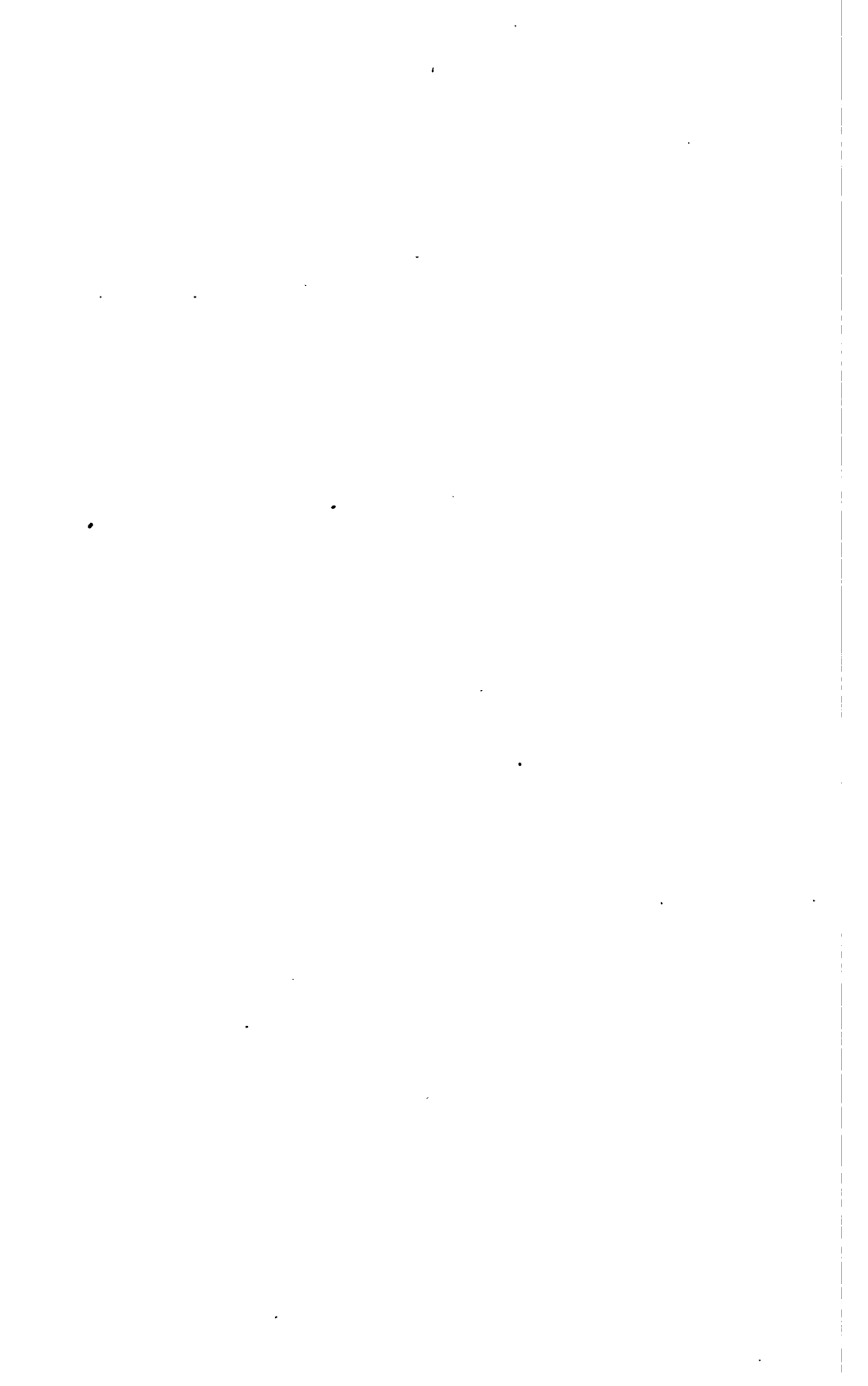
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